Article

Research on the governance dilemma and sustainable mechanism innovation of urban household waste classification

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Abstract: With the rapid advancement of urbanization in China, the amount of urban household waste generated continues to increase, and the phenomenon of "garbage encirclement" is becoming increasingly serious.This article systematically explores the main challenges faced by current garbage classification work in government management, market operation, and social participation through field research and case analysis.Research has found that there are problems at the government level such as movement style governance and poor departmental coordination;At the market level, there are challenges such as an imperfect recycling system and a broken industrial chain;On the social level, it manifests as difficulties such as low resident participation and weak classification awareness.In response to these issues, this article will propose a series of innovative paths, including improving the legal and regulatory system, promoting intelligent classification equipment, and building a diversified governance pattern, aiming to provide theoretical references and practical guidance for promoting the transformation of China's urban garbage classification work from short-term governance to long-term governance.

Keywords: Garbage classification; Governance dilemma; Sustainable mechanisms; Pluralistic governance; Policy innovation

1. Introduction

The current urbanization stands out in developing countries, especially in China, where the population size is much larger than before.The amount of urban household waste generated is showing a sustained and rapid growth trend.According to data released by the Ministry of Housing and Urban Rural Development, the amount of urban household waste cleared in China in 2022 has reached 250 million tons, an increase of about 15% compared to five years ago.Especially in densely populated large and medium-sized cities, the long-term overloaded operation of garbage treatment facilities has become an important issue restricting the sustainable development of cities, and the phenomenon of "garbage encirclement" has become a major problem.To address this phenomenon, open-air dumping, traditional land filling, or incineration (Nhung, 2023) have begun to emerge, but this method not only occupies a large amount of land resources, but incineration may also cause secondary pollution (Wang et al., 2026).Causing serious environmental pollution and resource waste.

To address this challenge, China has continuously introduced policies (Liu et al., 2025) and implemented a mandatory classification system for household waste nationwide since 2017.Taking Shanghai as an example, the city officially implemented the "Shanghai Municipal Solid Waste Management Regulations" in July 2019, becoming the first city in China to implement mandatory classification of household waste.Subsequently, 46 key cities including Beijing, Shenzhen, and Guangzhou successively introduced local regulations and gradually established garbage classification management systems with local characteristics.The implementation of these policies has improved the urban environment to a certain extent and enhanced residents' environmental awareness.

However, in the process of policy implementation, various regions have generally encountered difficulties in implementation, sustainability, and effectiveness.Many cities have achieved significant results through high-intensity investment in the early stages of policy implementation, but over time, the classification effect has shown varying degrees of decline (Abraham et al., 2023).This phenomenon of "high opening and low going" exposes the deep-seated institutional and mechanism problems in the current garbage classification work, which urgently need to be solved through systematic research and innovative practice.

In order to address the above issues, this study mainly focuses on the following three aspects: firstly, a brief description of the current situation of urban household waste classification and management;Secondly, the system analyzes the main challenges and their causes facing the current classification and management of urban household waste;Finally, propose innovative paths and implementation strategies for garbage classification and management that are in line with the actual situation in China.In terms of research methods, this article adopts a diversified combination of research methods: firstly, literature analysis method, which systematically sorts out relevant theoretical research and practical cases at home and abroad;The second method is field research, which obtains first-hand information through field investigations of leading cities such as Shanghai, Hangzhou, and Xiamen;The third is the case comparison method, which selects representative urban cases for in-depth analysis and comparative research;The fourth is the system analysis method, which regards garbage classification as a complete governance system and analyzes the interrelationships and mechanisms of various elements in the system.

2. Current situation of urban household waste classification governance

Nowadays, cities are promoting the classification of household waste, and the overall progress is slow and effective, but there are still shortcomings, which can be divided into two aspects.

On the one hand, there has been significant progress.Firstly, the coverage is becoming wider and wider. Most residential areas, schools, shopping malls and other public places in cities have installed classified garbage bins. Some cities have achieved full coverage of garbage classification in residential areas and public institutions, and the harmless treatment rate of household waste can reach 100%.Secondly, everyone's awareness of classification has become stronger than before. The community will organize science popularization activities, volunteer services, and encourage participation through the exchange of points for gifts. Young people are also willing to actively search for classification knowledge. The specialized collection of recyclable materials and kitchen waste is also increasing, and a lot of waste can be turned into treasure.In addition, recycling facilities are also being improved, with specialized recycling outlets and sorting centers established, gradually increasing the utilization rate of resource recycling.

On the other hand, there are also many unresolved issues.One reason is that many people do not have a high level of actual participation. Even if they know they need to sort, they feel that it is troublesome to do so. When they actually put it in, they randomly mix it up, and the accuracy of classification is low, especially for kitchen waste and recyclables, which are often misclassified.Secondly, there are shortcomings in the facilities, such as limited space in old residential areas, insufficient and poorly maintained garbage bins, and some collection points that have been built but have not been put into use or even left idle;It is also difficult to locate collection points, which can easily cause dissatisfaction among residents.Thirdly, the follow-up management is not in place, and some community properties do not attach importance to it. There is a situation of mixed collection and transportation of garbage, and the garbage sorted at the front end is mixed together during transportation, making the sorting process useless.

Overall, there has been basic progress in garbage classification, but there are still some difficult problems to solve, which require us to continuously improve and refine our systems.

3. The governance dilemma of urban household waste classification
3.1 Government level

Firstly, sports based governance is difficult to sustain.Currently, many cities are still accustomed to adopting a sport based management model in the process of promoting garbage classification.This model often manifests as: in the early stages of policy implementation, administrative orders are used to exert pressure layer by layer, mobilizing a large amount of manpower and material resources for centralized rectification;After achieving significant results in the short term, due to the lack of long-term mechanisms, the governance efforts gradually weakened and problems rebounded.For example, in the first month of implementing garbage classification in a certain city, tens of thousands of volunteers were mobilized to participate in bucket front duty, and the classification accuracy quickly increased to over 80%;But three months later, as the number of on duty personnel decreased, the classification accuracy dropped

to around 50%.This' gust of wind 'style governance not only causes waste of administrative resources, but also damages the credibility of the government.

Secondly, the departmental coordination mechanism is not smooth.Garbage classification involves multiple government departments such as environmental sanitation, housing and construction, development and reform, environmental protection, and commerce. However, due to the lack of effective coordination mechanisms, there is often a phenomenon of multiple departments and overlapping responsibilities.Specifically, the environmental sanitation department is responsible for garbage collection and transportation, the commerce department manages the recycling of renewable resources, the environmental protection department supervises environmental pollution prevention and control, and there is a lack of effective coordination between various departments.For example, in a survey conducted in a certain city, it was found that due to the unclear rights and responsibilities of the environmental sanitation department and the commerce department in the management of recyclable materials, the classified recyclable materials could not enter the recycling channel in a timely manner, and could only be incinerated, which seriously dampened the participation enthusiasm of residents.

The final supervision and assessment system is not perfect.At present, the supervision and assessment of garbage classification in many places are still mainly result oriented, focusing on surface indicators such as classification coverage and resident awareness, while paying insufficient attention to key indicators such as classification effectiveness and resource utilization level.This assessment method can easily lead to formalism in grassroots units to cope with inspections.For example, some communities focus mainly on producing promotional materials and organizing promotional activities in order to improve statistical indicators, but lack investment in daily classification guidance and supervision, resulting in classification work remaining on the surface.

3.2 Market level

Firstly, the recycling system in our country is not sound.There are obvious structural defects in China's domestic waste recycling system, and the phenomenon of "rushing to collect large profits and not collecting small profits" is widespread.For high-value recyclable materials such as scrap metal and paper, the market has a high level of enthusiasm for recycling;However, for low value recyclable materials such as waste glass and waste textiles, due to high recycling costs and low utilization value, they often go unnoticed.According to statistics, less than 30% of the waste glass generated in a certain city every year goes into recycling channels, while the rest is buried or burned, which not only causes resource waste but also increases environmental burden.

Secondly, the industrial chain is incomplete.Garbage classification involves multiple links such as disposal, collection, transportation, and treatment, and requires a complete industrial chain support.However, there are obvious shortcomings in the current waste sorting industry chain in China, mainly manifested in: firstly, insufficient terminal processing capacity, especially the lagging construction of kitchen waste treatment facilities;Secondly, the level of resource utilization is not high, and the market recognition of recycled products is low;The third issue is the poor connection between various links in the industrial chain, with the phenomenon of "detailed classification at the front end and one pot cooking at the back end" occurring from

time to time.These problems result in ineffective utilization of the classified garbage, affecting the operational efficiency of the entire classification system.

Thirdly, the participation of market entities is not high.Due to the strong public nature of garbage classification, the investment return cycle is long, the profitability is weak, and the willingness of social capital to participate is generally low.Especially in the fields of kitchen waste disposal and utilization of low value recyclables, the degree of marketization is relatively low, mainly relying on government subsidies to maintain operations.This situation not only increases the financial burden, but also restricts the innovative development of the waste sorting industry.

3.3 Social level

Firstly, residents lack motivation to participate.Although most residents agree with the environmental significance of garbage classification, their actual participation is still not high.According to a survey conducted in five cities, only 46.2% of respondents stated that they are able to persist in garbage classification.The main factors affecting residents' participation include: overly complex classification standards, inconvenient facility deployment, and high time costs.Especially in fast-paced urban life, residents tend to prefer a convenient lifestyle and are unwilling to spend too much time on garbage disposal.

Table 1. Survey of garbage classification in five cities

City	Sample size for adjustment (parts)	Garbage classification support rate	The primary obstacle factor
Shanghai	400	47%	Difficulty in fixing the delivery time (41%) Doubts about the export of low value recyclables (38%)
Beijing	400	46%	Large floating population makes it difficult to form a community atmosphere (45%) The classification criteria are too complex (40%)
Guangzhou	400	43%	Insufficient coverage of facilities in urban villages and other areas (44%)
Shenzhen	400	44%	Fast pace of life, high time cost (49%)
Xiamen	400	51%	Difficulty in managing mobile waste in tourist cities (37%)
Total	2000	46.2%	

Figure 1. Support rate of garbage classification in five cities
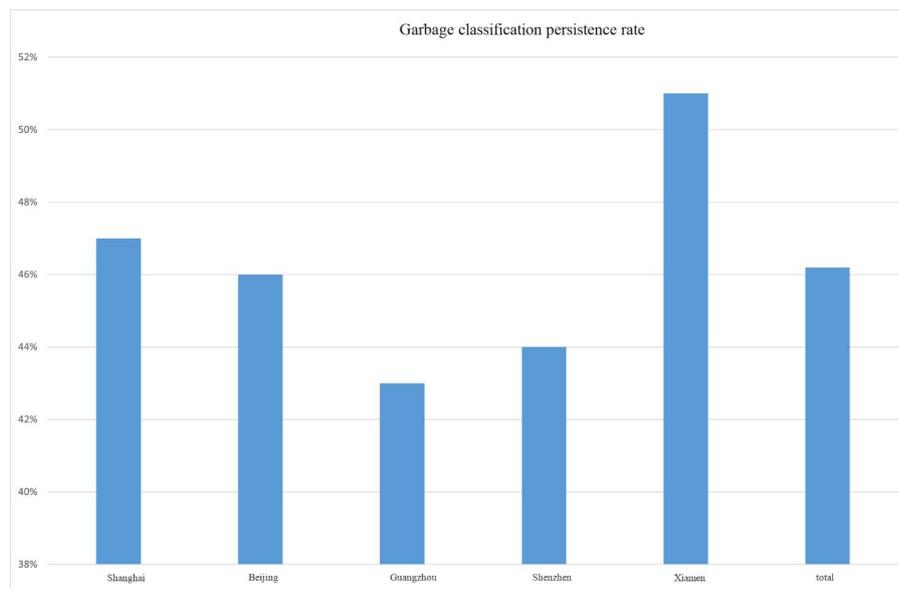
Secondly, there is insufficient mastery of classification knowledge.Many residents have a willingness to classify, but due to a lack of systematic classification knowledge, errors often occur in practical operations.A survey shows that over 60% of residents are unable to accurately distinguish between kitchen waste and other waste, especially for special types of waste such as large bones, corn cobs, etc., with a higher error rate.This situation not only affects the classification effect, but also increases the difficulty of subsequent processing.

Finally, the community governance capacity is weak.As the grassroots organizational unit for garbage classification, communities play a key role in mobilizing residents to participate and conducting daily supervision.However, many communities currently face the problem of insufficient governance capacity: firstly, there is a lack of professional strength, and community workers often hold multiple positions, making it difficult for them to focus on garbage classification work;Secondly, the autonomous mechanism is not sound, and the cooperation between residents' committees, property management companies, owners' committees and other entities is not smooth;Thirdly, the volunteer service system is not perfect, making it difficult to form a sustained and effective supervisory force.

4. Sustainable mechanism for urban household waste classification: innovative measures and implementation paths

4.1 Government level

4.1.1 Improve the legal and regulatory system

Establishing a sound legal and regulatory system for garbage classification is the foundation for promoting long-term governance.Due to the difficulty of sustainable sports style governance, firstly, it is necessary to accelerate the formulation of a national special law on garbage classification, clarify the rights and obligations of all parties, unify classification standards and management requirements.Secondly, each region should formulate supporting local regulations and implementation rules based on actual situations, to enhance the operability of legal provisions.Once again, it is necessary to establish and improve a law enforcement

supervision mechanism, ensuring the implementation of laws and regulations through regular inspections, random checks, and other methods, in order to promote the long-term development of garbage classification.

4.1.2 Building a diversified governance pattern

To address the issue of poor coordination mechanisms among departments, it is necessary to first clarify the roles and responsibilities of the government, market, and society in garbage classification and management.The government should play a leading role and focus on planning, standard setting, regulatory enforcement, and other related work;Market entities should actively participate and be responsible for classification collection, resource utilization, and market-oriented operation;Social organizations and residents should actively participate, do a good job in source classification, community supervision, publicity and education, and form a pattern of complementary advantages and collaborative governance.

4.1.3 Optimize the assessment and evaluation mechanism

The imperfect supervision and assessment system has led to formalism. To establish a scientific assessment and evaluation system, we need to shift from focusing on the process to focusing on effectiveness, and from a single indicator to comprehensive evaluation.Specifically, it is necessary to establish a multidimensional evaluation index system that includes classification accuracy, resource recovery rate, reduction effect, and public satisfaction, and link the evaluation results with government performance evaluation, cadre appointment, etc., to form an effective incentive and restraint mechanism.

4.2 Market level
4.2.1 Enhancing Resource Utilization Technology

Strengthen the research and promotion of waste resource utilization technology.In terms of kitchen waste treatment, we will focus on developing efficient anaerobic fermentation, aerobic composting, insect farming and other technologies to improve resource conversion efficiency.In terms of the utilization of recyclables, breakthroughs have been made in key technologies such as sorting and recycling of low value recyclables to improve resource recovery rates.In terms of hazardous waste disposal, we will improve the technical system for safe disposal and resource utilization, and prevent environmental risks.

4.2.2 Improve the integrity of the industrial chain

Open up the 'exit' of garbage.After the subdivision of garbage, there is no way out, especially for kitchen waste. Increasing the number of kitchen waste treatment facilities can turn garbage into fertilizer and biogas.The government provides subsidies to enterprises for recycling old materials, encouraging them to be willing to recycle and utilize their waste.On this basis, the government will strengthen the promotion of recycled products and enhance their market recognition.Special vehicles are used for transporting different types of garbage, such as green vehicles for transporting kitchen waste and blue vehicles for transporting recyclables.We also need to establish a clear collection and transportation schedule to enable residents to supervise and improve their enthusiasm.

4.2.3 Innovation Policy Incentive Mechanism

Designing a scientifically reasonable policy incentive mechanism is the key to enhancing the participation enthusiasm of all parties.For enterprises, it is necessary to implement the extended producer responsibility system, requiring production enterprises to bear the responsibility of product recycling and disposal. At the same time, measures such as tax incentives and funding subsidies should be taken to encourage enterprises to participate in garbage classification and resource utilization, and enhance their internal motivation to participate in the garbage classification industry.For example, establishing a stable investment return mechanism, the government can provide enterprises with stable expected returns through long-term procurement of services, guaranteeing processing costs, and other means.Or enhance the economic benefits of resource utilization and optimize the market environment.

4.3 Social level

4.3.1 Strengthen publicity, education and guidance

Establish a normalized publicity and education mechanism.One of the main problems now is insufficient publicity.(Hu, 2021) Firstly, we need to promote the popularization of classification knowledge, and help residents master the correct classification methods through community bulletin boards, special lectures, on-site guidance, and other forms.Secondly, we need to innovate our promotional methods, utilizing modern tools such as new media platforms and interactive experience devices to enhance the fun and effectiveness of our publicity.We should pay attention to habit cultivation, incorporate garbage classification into the national education system, start from childhood, and cultivate the environmental awareness and behavioral habits of the new generation of citizens.For residents, a "green account" system can be established to link classified behavior with credit records, public services, etc., and provide positive incentives through points redemption, fee reductions, and other methods (Qian et al., 2025), in order to increase residents' participation motivation.

4.3.2 Promote intelligent classification devices

Applying modern information technology to enhance the intelligence level of garbage classification.One is to promote intelligent recycling equipment, which can improve classification efficiency and accuracy through functions such as automatic recognition, weighing and measurement, and data collection.The second is to build a smart management platform to achieve visual management and precise scheduling of the entire process of garbage generation, classification, transportation, and treatment.The third is to develop a convenient service platform, which provides residents with convenient services such as classification queries, appointment recycling, etc. through mobile apps, mini programs, and other tools.

4.3.3 Strengthening Community Governance Capability

Enhance the organizational and mobilization capabilities of the community in garbage classification work.We need to strengthen our work force and enhance the community's garbage classification and management capabilities through the establishment of dedicated positions and the purchase of professional services.Secondly, we need to improve the autonomous mechanism,

fully leverage the roles of residents' committees, property management companies, owners' committees and other entities, and form an internal coordination and linkage mechanism within the community.We must cultivate a volunteer team, mobilize community party members and enthusiastic residents to participate in daily supervision and guidance, and create a good atmosphere of self-management and self-service among residents.

5. Conclusion and Suggestions

5.1 Main conclusions

Through a systematic study of the challenges and sustainable innovation paths in the classification and management of urban household waste, the following main conclusions can be drawn: firstly, China's urban household waste classification work has entered a critical period, and it is difficult to achieve long-term treatment goals solely relying on administrative orders and dynamic governance.We must carry out systematic reforms from multiple dimensions such as institutional construction, technological innovation, and governance models, and build a new governance pattern where the government, market, and society work together.Secondly, the root cause of the dilemma in garbage classification and management lies in the imperfect institutional mechanisms.The government's exercise style governance, poor departmental coordination, inadequate recycling system and incomplete industrial chain at the market level, insufficient participation of residents at the social level, and weak community governance capabilities are intertwined, jointly constraining the in-depth development of garbage classification work.Thirdly, to promote sustainable development of garbage classification, it is necessary to establish a complete system of institutional safeguards.This includes improving the legal and regulatory system to provide legal protection for garbage classification;Innovate policy incentive mechanisms and mobilize the enthusiasm of all parties to participate;Optimize the assessment and evaluation mechanism to ensure effective work.Fourthly, technological innovation is an important support for improving the efficiency of garbage classification.To improve the scientific, refined, and intelligent level of garbage classification, measures such as promoting intelligent classification devices, enhancing resource utilization technology, and improving the classification and transportation system should be taken.Fifth, building a diversified governance pattern is the key to achieving long-term management of garbage classification.We need to clarify the roles of government, market, and society, strengthen community governance capabilities, enhance publicity, education, and guidance, and create a good situation where the whole society participates together.

5.2 Policy Suggestions

Based on the above research conclusions, this article proposes the following policy recommendations: firstly, strengthen top-level design and improve the legal and regulatory system.It is suggested to accelerate the formulation of the "Household Waste Management Law", clarify the overall goals, basic principles, management systems, and safeguard measures of waste classification.Each region should formulate implementation rules based on its actual situation, and form a legal normative system that is interconnected and fully supported.

Secondly, innovate institutional mechanisms to stimulate market vitality.We need to deepen the reform of "streamlining administration, delegating powers, and improving services"

in the field of garbage classification, break down market access barriers, and encourage social capital to participate in garbage classification and resource utilization.Improve the pricing mechanism and fiscal policies, establish and improve the garbage disposal fee system, and enhance the endogenous development momentum of the garbage classification industry.

Thirdly, increase investment in technology and enhance the level of intelligence.Suggest establishing a special project for garbage classification technology to support the research and development of key technologies such as intelligent recognition, efficient sorting, and resource utilization.Promote the application of modern information technologies such as big data, Internet of Things, and artificial intelligence in the field of garbage classification to enhance management efficiency.

Fourth, strengthen grassroots construction and enhance governance capabilities.We need to strengthen guidance and support for grassroots garbage classification work, and allocate sufficient and strong work forces.Improve community governance mechanisms and leverage the mobilization and coordination role of grassroots organizations.Strengthen talent cultivation and build a specialized workforce.

Fifth, deepen publicity and education, cultivate environmental protection culture.We should incorporate garbage classification into the national education system and cadre training content to enhance the environmental awareness of the whole society.Innovate publicity methods, leverage the role of new media, and create a good atmosphere where everyone participates and fulfills their responsibilities.

5.3 Research Prospects

With the deepening of garbage classification work, future research can be further deepened in the following areas: firstly, strengthening the study of long-term mechanisms for garbage classification, especially innovative practices and theoretical summaries in market-oriented operations, social participation, and other aspects.

The second is to conduct research on the relationship between garbage classification and carbon peak and carbon neutrality, and explore ways and methods to promote synergistic efficiency in pollution reduction and carbon reduction through garbage classification.

The third is to deepen the innovation research of garbage classification technology, especially the breakthroughs and promotion of core technologies in intelligent classification, resource utilization and other fields.

The fourth is to strengthen international comparative research, draw on the successful experience of developed countries in the field of garbage classification, and carry out localized innovation in combination with China's actual situation.

In short, promoting the classification of urban household waste is a long-term and arduous task that requires the joint efforts of the government, enterprises, society, and residents.Through institutional innovation, technological innovation, and governance innovation, building a garbage classification and management system that is in line with China's national conditions will undoubtedly make important contributions to building a beautiful China and achieving sustainable development.

AUTHOR CONTRIBUTIONS

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CONFLICT OF INTEREST STATEMENT

The authors declare that there are no commercial or financial relationships that could be construed as a potential conflict of interest.

DATA AVAILABILITY STATEMENT

The data generated and analyzed in this study are available from the corresponding author upon reasonable request. All data will be provided without undue restriction.

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