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Study on the Benefits of Separate Recycling of Municipal Domestic Waste and Recommendations on Relevant Countermeasures

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ABSTRACT

As urbanisation progresses and living standards improve, the volume of domestic waste has risen sharply, leading to increased attention from government agencies towards managing urban domestic waste. The effective classification and recycling of rubbish has become a widely discussed topic in the society. This paper studies the economic and social benefits of sorting and recycling urban household waste. It also analyses the status quo and challenges associated with sorting and recycling urban household waste in China. To address these challenges, the paper puts forward several improvement strategies and suggestions to enhance the promotion and implementation of sorting and recycling urban household waste in China. These strategies aim to promote the healthy and sustainable development of the economy and society.

KEYWORDS

Waste Separation and Recycling; Benefits; Research; Countermeasures.

1. INTRODUCTION

China's municipal waste is growing at a rapid rate, and the country is gradually becoming one of the world's most serious "rubbish surrounds the city" countries due to the country's rapid urbanisation, population growth, rising living standards, and development of the chemical industry. At present, the accumulation of domestic waste in China over the years has reached more than 5 billion tonnes, and the annual production of urban waste has reached 150 million tonnes, with an average annual growth rate of 8% [1]. Tens of thousands of tonnes of rubbish are piled up all over the city, posing real and potential environmental hazards. In some cities, this has even slowed down the process of urban construction and restricted the local economic development. In conclusion, the massive volume of municipal waste not only results in more severe environmental issues but also places a rising financial strain on society during collection, transportation, and disposal.

Reducing the difficulty and cost of disposing of home garbage, increasing the rate at which waste is converted to resources, and lowering waste separation and recycling rates are all significant aspects of waste management solutions. China put forward the concept of waste classification and recycling as early as 1957, and put forward specific requirements in the form of official documents of the State Council in 1992, and then carried out many years of systematic exploration, pilot operation, and put forward the goal of basically completing the waste classification and recycling treatment system in cities above the prefecture level nationwide in 2025 [2]. Studying the economic and social advantages of garbage categorization and recycling in metropolitan areas is crucial at this vital juncture of

research. It is also important to identify the shortcomings and limitations in this process and develop optimization techniques that will address them.

2. BENEFIT ANALYSIS OF SEGREGATED MUNICIPAL WASTE RECYCLING

2.1. Economic Benefits

2.1.1. Separation and Recycling of rubbish Can Lead to the Recycling of Resources

The renowned statement made by Lasky, the chief expert of the United Nations Environment Programme, states that rubbish is a misplaced resource and the only resource that is ever-growing and never-exhausting on Earth. Waste may be separated and treated in a way that maximizes the recovery of useful materials, turning waste into treasure and yielding significant economic advantages. For example, one tonne of recycled waste paper can be refined into 850 kg of good paper, saving 300 kg of wood; one tonne of recycled waste steel can be refined from 0.9 tonnes of good steel, saving 47% of the cost of smelting; one tonne of recycled waste plastics can be refined from 600 kg of diesel fuel; even ash can be made into building materials; and waste materials like leaves and peels can be recycled into green fertilizer. According to relevant statistics, China's cities annually discarded recyclable waste is worth about 30 billion yuan [3], and as the first for the "rubbish economy" legislation of the country Germany, its rubbish reuse industry to create an annual output value of 41 billion euros [4].

2.1.2. Separation and Recycling of Rubbish Can Reduce the Cost of Rubbish Disposal

Domestic waste can be categorized and recycled to allow for the processing of a significant amount of resources into products by qualified businesses. This not only minimizes resource waste but also lowers the overall amount of waste that enters the terminal treatment system, easing the burden of waste collection and disposal and lowering treatment costs associated with labor, material resource and equipment waste, etc. [5] and bringing obvious economic benefits. Using Shanghai's domestic waste disposal in 1998–2000 as an example, some people set the prevalence rates of recycling and classification at 25% and the efficiency rates of classification at 80%. They then estimate that the total amount of waste reduced in three years will be 905,100t, and since the cost of treating and transporting waste is 60 yuan per tonne, this can reduce the cost of treating and transporting waste by an average of 18.102 million yuan annually. [6].

2.2. Ecological Benefits

2.2.1. Separation and Recycling of Rubbish Can Save Land Resources

Currently, 2/3 of the cities in China are surrounded by rubbish, and 1/4 of the cities lack landfill sites. The Asuwei landfill in Beijing, which cost 100 million yuan and covers an area of 60 hectares, only manages to dispose of 1/5 of the city's rubbish, with a lifespan of approximately 11 years. If waste separation and recycling are implemented, at least 40% of Beijing's domestic waste landfill can be reduced, thereby extending the lifespan of the landfill and alleviating the city's challenges in land resource acquisition. With the development of recycling and processing technologies, the increasing proportion of waste recycling will protect more and more land from the menace of waste.

2.2.2. Garbage Classification and Recycling Can Reduce Environmental Pollution

Nowadays, the majority of China's urban household waste ends up in sanitary landfills, or simply basic landfills. These landfills are overflowing with flies and insects, and the odor is so bad that it severely pollutes the surrounding area. Furthermore, a large amount of chemical waste is found in household waste, including organic solvents found in cosmetics, mercury, cadmium, and sulfuric acid in batteries, and chlorine in plastics that are difficult to break down, etc.

If these wastes are simply disposed of in landfills, it will not only fail to reduce environmental pollution, but also cause potential harm to the environment. The toxic components in these wastes will not decompose completely in the landfill, and may seep into the surrounding soil and groundwater, leading to pollution of the neighboring soil and water sources. The pollutants may also enter the human body through crops, aquatic organisms, or other food chains, posing a serious threat to human health. Therefore, it is not advisable to directly landfill mixed domestic waste, and alternative disposal methods should be explored to ensure environmental protection and public health safety[7]. Additionally, waste incineration emits harmful substances such as carbon monoxide, sulphur dioxide, and dioxins. By separating and recycling domestic waste, we can reduce environmental pollution by transporting hazardous waste to professional enterprises for safe disposal[8]. This approach not only reduces environmental pollution but also lowers the government's investment in environmental pollution control.

2.3. Social Benefits

2.3.1. Waste Separation and Recycling Can Enhance Public Awareness of Environmental Protection

By promoting knowledge about the proper separation of household waste and implementing effective publicity and education measures, the concept of environmental protection can be firmly instilled in the minds of the public. This will significantly enhance the public's awareness of environmental protection, encourage them to gradually cultivate good habits of waste separation and resource conservation, and ultimately improve the overall quality of the nation.

2.3.2. Separation and Recycling of Rubbish Can Optimize the Human Environment

The implementation of waste separation and recycling reduces the accumulation of organic matter in rubbish, minimizes the emission of odorous gases, inhibits the growth of mosquitoes and other insects, cuts off the spread of certain diseases, lowers the risk to human health, optimizes the environment for people, and improves the flavor of the city.

2.3.3. Separation and Recycling of Rubbish Can Promote Sustainable Development

By implementing waste separation and recycling practices, recyclable materials can be effectively utilized again, thereby prolonging the lifespan of resources, minimizing the requirement for new resources, reducing the material production costs in society, and enhancing the ecological environment. This, in turn, promotes the sustainable development of society.

3. CURRENT SITUATION AND PROBLEMS IN THE SEPARATION AND RECYCLING OF URBAN DOMESTIC WASTE IN CHINA

3.1. Current Situation of Separate Recycling of Urban Household Waste in China

In June 2000, Beijing, Shanghai, Nanjing, Hangzhou, Guilin, Guangzhou, Shenzhen, and Xiamen were chosen as pilot cities for waste classification and recycling. In 2010, recycling and waste classification began to be promoted in many parts of the country. Especially in July 2019, with the official implementation of the Shanghai Municipal Domestic Waste Management Regulations [9], China entered the era of mandatory rubbish classification. By the end of 2020, 46 cities nationwide had mandated the classification and recycling of household waste, and a more comprehensive treatment system have been gradually built up, which has achieved certain results.

However, due to the late start of waste separation and recycling in China, there is still a gap in the technology and systems compared with that of developed countries, and the implementation process is time-consuming, with a number of problems.

3.2. Problems

3.2.1. Residents Have a Low Awareness of Waste Classification and an Insufficient Stock of Classification Knowledge

At present, many residents do not realize the importance of domestic waste classification, perceiving it as a bothersome task that necessitates a departure from their inherent living habits. At the same time, due to their busy schedules, fast-paced lifestyles and other factors, residents exhibit low levels of policy acceptance, exhibiting a lack of cooperation or even resistance. Moreover, the absence of a systematic understanding of rubbish classification hinders residents' abilities to correctly sort and dispose of waste, which subsequently undermines their motivation and initiative. This results in their reluctance to allocate time and effort to sorting garbage, ultimately leading to suboptimal classification outcomes.

3.2.2. Policies and Regulations Related to the Classification of Domestic Waste are Not Sound

China's urban household waste classification was established much later than other countries; further flaws include a lack of complete laws and accompanying regulations, legislation that is too principled, unclear legal accountability, and other issues. For example, local people's governments at all levels shall take measures to organize the categorization and disposal of household waste, recycling, and utilization, according to Article 37 of the Environmental Protection Law. However, the document leaves out important details regarding classification as well as applicable rewards and penalties, which leads to ambiguous language and lax enforcement.

3.2.3. Lack of Perfect and Effective Supervision and Reward and Punishment Mechanisms

The smooth implementation of the policy requires a strong regulatory mechanism to assist, yet current domestic waste classification efforts lack rigorous supervision from designated departments or agencies. The division of responsibilities is unclear and unspecified, resulting in inadequate implementation of the policy. Moreover, there are insufficient incentives for the classification of domestic waste, which fails to mobilize the enthusiasm of the residents; and there are fewer penalties for non-compliance with laws and regulations, which results in residents' lack of attention and hindering the effective promotion of waste classification and recycling efforts.

3.2.4. The Embarkations and Industrialization of Domestic Waste Classification and Recycling is Low

At present, China's urban living rubbish classification and recycling is dominated by the government's behaviour, and the level of embarkations is low, resulting in outdated policies, low efficiency and heavy financial burden [10]. The project's ability to move forward smoothly is hampered by the unsound industrial chain of rubbish classification, which has not yet developed a scientific and ideal industrialization system of classified placement, classified collection, classified transportation, and classified treatment. Additionally, the relevant industrial technology and experience are likewise in their infancy and less lucrative.

4. COUNTERMEASURES AND RECOMMENDATIONS TO ADDRESS THE PROBLEM

4.1. Strengthen Environmental Protection Publicity and Education on Waste Classification

The relevant departments can continue to popularize the meaning and knowledge of rubbish classification among the general public through various channels and strengthen their concept of

rubbish classification. This will foster a positive social environment where everyone actively participates in environmental protection, conserves resources, and cares for the environment. Additionally, it may be beneficial to produce and distribute comprehensive manuals on waste classification or create and promote short educational programs on waste classification for easy access by residents. For example, the municipal department of Vienna, the capital of Austria, has prepared an 80-page guide on rubbish classification, which has become an essential reference for every citizen[11].

4.2. Continuously Improve Laws and Regulations Related to Waste Classification

The government should formulate and improve relevant laws and policies to provide an important guarantee for the promotion of rubbish classification. For example, it can introduce a unified standard for rubbish classification in cities across the country, and implement tax relief and financial subsidy policies for rubbish classification and recycling enterprises, and so on. First and foremost, Germany is in the leading position in the world in terms of urban waste classification thanks to its perfect legislation on waste classification. Germany has enacted more than 800 relevant laws and nearly 5000 administrative regulations, from the source of rubbish classification to the end of the treatment of the law[12].

4.3. Establishment of a Complete Regulatory, Reward and Punishment Mechanism

The popularization and solidification of rubbish classification requires a long-term process, in which a strong regulatory system and a reward and punishment mechanism should be established to promote rubbish classification in practice through rigid constraints and positive incentives. For instance, the use of rubbish ladder charges, classification charges and other price means and rubbish deposit, recycling points and other incentives to encourage residents to consciously carry out waste reduction and classification.

In Nanjing, residents can exchange "green points" for eggs, detergent and other services [13]. In South Korea, the government has set up a strict monitoring and enforcement system, installing camera surveillance equipment at each domestic waste collection station and implementing a reward system for reporting illegal waste disposal.

4.4. Enhance the Marketization and Industrialization of Waste Separation

To promote the professional and large-scale development of the rubbish recycling and treatment industry, the government should actively encourage private enterprises to participate in rubbish classification, collection, disposal, and operation services. To this end, the government should provide various policy supports, strengthen market cultivation, and fully leverage the role of the market in facilitating the process of rubbish classification and recycling. At the same time, the government should strengthen the construction of the rubbish recycling and treatment industry chain by establishing a comprehensive industrialization system for classification, collection, transportation, and treatment. To enhance the utilization rate of rubbish resources, the government should increase research and development efforts on related technologies. For example, Germany has introduced private enterprise Raymond and other social capital to participate in rubbish management, using market competition to improve the efficiency of rubbish management. Singapore has formed a waste classification industry chain system with state-owned enterprises as the mainstay and private enterprises as the supplement, which strongly promotes the smooth implementation of waste classification and recycling.

5. CONCLUSION

At a time when environmental pollution is becoming increasingly serious and the earth's resources are being depleted, the separation and recycling of urban household waste is undoubtedly an important way to create social well-being and promote the harmonious development of man and society. This endeavour, which cannot be achieved overnight, necessitates a comprehensive and sustained effort. It is imperative that we distill the lessons learned from pilot projects, borrow insights from global best practices, utilize legislative and economic tools judiciously, and mobilize the entire society. This way, we can expeditiously embark on an ecological trajectory towards minimal waste, optimal resource utilization, and total harmlessness.

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