Exploring the effects of waste sorting on plants and their diversity using a literature analysis approach

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Abstract. Waste separation is one of the key topics of research today. Researchers have found that unsorted waste is caused by people's weak environmental awareness and inadequate policies, yet there is a research gap on the impact of unsorted waste on plants. Therefore, the research topic of this paper is to explore the effect of unsorted waste on plant growth and its diversity. The research method of this paper is as follows, firstly, we read the literature to collect the background and reasons leading to the unsorted waste from government, people and biological levels. Secondly, data on heavy metal content in soil were collected to analyze the effects of their heavy metals on plants. The study showed that excessive heavy metal content in soil has a negative impact on the growth of plants and is detrimental to the growth of plants and the conservation of their diversity. Therefore, the correct sorting and disposal of waste contributes to the sustainability of the environment, and thus to the growth of plants and their diversity.

Keywords: Waste management, recycle, behaviour change, pollution, soil, phytology, soil, phytology.

1. Introduction

Unseparated waste destroys ecological balance and harms plant growth and its diversity becoming a social concern. With the rapid development of economy and the improvement of people's consumption level, urban waste is increasing rapidly at an alarming rate, which creates great difficulties for waste classification and treatment, and improper waste disposal has a great negative impact on the natural environment and people's living environment. In 2004, the Ministry of Construction of China issued the guidelines for waste separation, which clearly stipulates the standards for urban domestic waste separation[1]. The seventeenth meeting of the Standing Committee considered and adopted the revised "Law on the Prevention and Control of Environmental Pollution by Solid Waste". There are clear classification standards for different types of waste.In addition, the lack of awareness of waste separation and the fact that local governments invest a lot of money in local economic construction and ignore waste separation have led to a large amount of waste being discarded or piled up on the land. In the process of decomposing and releasing these waste, a large amount of sulfur and nitrogen compounds will be produced, which will produce an unpleasant odor, not only harmful to human body, but also pollute the atmosphere. Some plants are on the verge of extinction because of this.

According to the study, most people think that it is too complicated to separate waste and that there is no official policy to promote it, so people do not know much about it. In terms of concrete practice, urban community waste separation and collection policies present a difficult situation to promote. Scholars believe that the reasons for the difficulty in promoting urban community waste separation and collection policies are residents' lack of awareness of waste separation, weak environmental awareness, and the lack of strong policy support and supporting implementation measures [2-3]. People have different perceptions and opinions about the implementation of waste separation. Although most people do not understand the details of waste separation, most people are willing to learn about waste separation and actively participate in it.

The purpose of this paper is to involve more people in the implementation of waste separation, so that different types of waste are disposed of correctly, thus improving the environment, benefiting plant growth and preserving plant diversity. For better understanding, the second part of the thesis is

a literature review on waste separation government, residents and biological chain. The third part of the thesis is about the background, reasons and recommendations of waste management. The final part of the thesis is the conclusions and results obtained through the study.

2. Literature review

At the government level, the central government issues policies and specific standards for waste separation, and local governments monitor and strengthen the implementation of the policies. As a manager, the government needs to fulfill the responsibility of coordinating and promoting the effective role of other governance subjects. The work of urban waste classification involves people's governments at all levels in cities, as well as many departments such as housing and construction, ecology and environment, education, and commerce. The unclear responsibilities of management subjects in each aspect of waste classification can lead to multiple management and overstepping, misplacing and missing functions. It is necessary to achieve a clear division of responsibilities and legalization of the scope of authority between the central and local governments and between government departments, and on this basis, improve the accountability mechanism to include the scope of responsibilities of government departments at different levels in the corresponding supervision and assessment system.

At the level of people's awareness, community residents are the main body of community waste sorting activities, and raising their awareness of waste sorting will have a positive effect on promoting the reform of the existing waste sorting system in line with it [4]. At the level of people's awareness, community residents are the main body of community waste sorting activities, and raising their awareness of waste sorting will have a positive role in promoting the reform of the existing waste sorting system in line with it. Residents' willingness to sort waste is influenced by subjective factors, such as environmental satisfaction and policy awareness [5]. Meanwhile, external factors are decisive to subjective factors, and their influence on individual willingness is gradually studied, such as external factors have more significant influence on residents' environmental behavior, residents' willingness to participate in less developed areas may be lower, and elements such as infrastructure, social publicity, environmental atmosphere and management strategy have significant influence on willingness to participate [6]. Therefore it is vital to raise awareness among residents.

At the biological level, according to studies, in recent years, the deterioration of air quality has seriously threatened the survival of human beings and the burning of waste is strictly prohibited at all levels, therefore, the main method of waste disposal is landfill [7]. The harmful elements and gases produced during the decomposition of waste are prone to secondary pollution of groundwater and soil and air, and these pollutions directly affect the growth environment of plants, such as the reduction of soil bulk and porosity, and the reduction of the number and species of soil microorganisms, etc. These changes indirectly affect the growth and development of plants and pose a great challenge to the conservation of plant diversity.

3. Waste management in China

3.1 The challenge of behaviour change in using classification to protect plants

3.1.1. Weak legal policies related to waste separation

Although China's pilot cities have issued some guiding documents on urban waste classification, these documents only provide guidance in principle for waste classification, and do not specify specific punitive measures and supervision means, so the laws and regulations do not play a binding role [8]. Secondly, the standard of domestic waste classification changes repeatedly. The problem of repeated changes in domestic waste classification standards and overly academic classification names is common in China's pilot cities, which creates barriers for people to learn and adapt to waste classification. In Shanghai, the first city in China to introduce mandatory waste separation, the current waste separation method has been changed five times. For example, "used toilet paper" has gone

through four different categories in Shanghai: inorganic, incinerable, food waste, and dry waste [8]. In terms of legal research, there is no separate system for the study of waste classification [9-10]. In addition, the provisions scattered in various sectoral laws or regulations are generally ill-defined and lacking in enforceability, making it difficult to implement them in practice [10].

3.1.2. Weak awareness of waste separation

People are the main body of waste separation. According to the research,in recent years, the awareness of environmental protection has been strengthened in China, but the implementation of action is not satisfactory. Due to the different personal qualities and lifestyles of residents, as well as the fact that they have not systematically learned about waste separation, they have not developed the habit of separating waste in their lives. Even if they know about waste separation, they are not willing to do it for convenience and convenience. Although many cities in China have bins for recyclable and non-recyclable waste, they are not functioning, and many people still do not follow the rules of waste separation when throwing away waste, which makes waste disposal more difficult [11]. Moreover, not only do the residents have no awareness of waste classification, but the staff responsible for waste removal also lack the relevant awareness of waste classification, and in the waste removal work, they will dump the waste together for the sake of convenience.

3.1.3 Waste Recycling

Domestic waste in China can generally be divided into four main categories: recyclable waste, food waste, hazardous waste and other waste. waste can be divided into toxic and hazardous waste, recyclable waste, kitchen waste and other waste. Toxic and hazardous waste includes: mercury thermometers, waste batteries, expired drugs, waste paint, etc. Recyclable waste includes metal, paper, fabric, glass and plastic, etc. Kitchen waste includes leftover food, fruit and vegetable residues and plastic bags. Other waste includes sludge, bricks and tiles, and toilet paper. Different types of waste are recycled and disposed of in different ways.It is difficult for each person to sort the waste correctly.

3.2 Factors of waste management

3.2.1 Insufficient knowledge about waste separation

Firstly, the meaningful awareness refers to the residents' awareness of the significance and importance of waste separation. The residents have some awareness of waste separation, but the awareness only reaches the general environmental issues, and there is no deeper awareness of environmental protection, so that many people discard the waste in the grass, lakeside and other places. Secondly, the subjective awareness of waste separation refers to whether the residents are aware of the information related to waste separation subjectively. Since there are few policies related to waste separation in China, the residents do not have a high degree of knowledge about the specific contents and management methods of the policies. Finally, the value perception of waste separation refers to whether residents' evaluation of the value of waste separation is in line with reality. Currently, most residents think that waste separation is meaningful to protect the environment, but due to the lack of mandatory laws, most residents do not put out their waste correctly[12].

3.2.2 Poor waste separation and disposal system

Landfills and incineration are the main disposal methods for urban domestic waste in China. Its landfill operation increases the content of heavy metals such as lead, manganese and cadmium in the landfill soil over time. In addition, the pH and organic matter content of the soil decreases continuously as the depth of landfill increases. Municipal waste also contains a large amount of batteries, electrical equipment and other items that contain heavy metals. According to the Table 1 indicates that all around the sorting and recycling of domestic waste for transfer are higher than the background value of local soil lead content (300 mg/kg^{-1}), and the mass fraction lead of heavy metal lead exceeds the standard more in the control area, which is significantly higher than the soil around the sorting and recycling of domestic waste for transfer.

Table 1 Pollution of lead and heavy metals in surface soil of 0～20 cm in different sampling area[13]

Soil sampling area	Number of samples	Number of samples with excessive lead	Mass fraction （mg/kg)	Amount of exceedance （mg/kg)
waste Transfer Station	4	2	486.36±26.28	186.36±26.28
10m from the transfer station	4	2	552. 14±18.73	252. 14±18.73
1km from the transfer station	4	1	311.91±22. 65	11.91±22. 66
Control area	4	3	621.39±2.43	321.39±2. 44

According to Table 2, excess Cd not only severely inhibits the growth of above-ground plant parts, causing a reduction in plant height, but also leads to significant chlorosis and necrosis of its leaves. In addition, roots are important nutrient absorption and metabolism organs of plants, and are also the first barrier for soil heavy metal Cd to enter plants, and its growth condition and metabolic intensity will directly affect the growth condition of plants. cd also limits the length of plant roots, and the efficiency of nutrient and water absorption decreases, which eventually affects the nutritional growth of plants[14].

Table 2 Effects of Cd on vegetative growth of higher plants[14]

Plant species	Cd concntrations	Conclusion
Apiumgraveolens L	≥10 mg•L^{-1}	Significantlyinhibitedseedlinggrowth
Arachis hypogaea L.	≥200umol•L^{-1}(22.48 mg-L^{-1})	Significantlyinhibitedseedlinggrowt
Vicia faba L.	10 umol•L^{-1} (1.12 mg•L^{-1})	Increased reactive oxygen species (ROS) and decreased cell division activity of root meristematic zone
Solanum lycopersicum L.	16.86 mg•L^{-1}	Inhibited root length and decreased nutrient absorption efficiency
Winter wheat	-	Significantly inhibited root length and affected the Absorption of water and mineral elements

3.2.3 Insufficient punishment

The rewards and penalties for waste separation implemented from May 2020 comprehensively address the hotspots of waste separation, and the rewards and penalties are not strong enough to get residents to voluntarily separate their waste. For example, some people throw their waste indiscriminately when unattended without regard to the consequences. Therefore, in order to upgrade the waste classification from an advocacy to an obligatory clause and turn it into an individual social obligation, the reward and punishment measures need to be further improved.

3.3 Suggestions on waste management

3.3.1 Strengthen the cooperation between social actor and government

The implementation of urban waste separation policy is not only the task of the government, but also the responsibility of all members of society. Firstly, it is necessary to improve the synergy between government departments. Set up a special department responsible for organizing and implementing relevant regulations and policies on domestic waste classification, and responsible for coordinating and organizing the construction work of domestic waste classification and its reward and punishment system in each community. Secondly, economic and legal means should be used to

encourage market players to participate in the promotion process of urban domestic waste separation policy. Thirdly, social organizations should be fully mobilized to participate in the classification of urban domestic waste. Fully mobilize relevant social organizations and community waste sorting volunteer teams, and include them extensively in the team of urban domestic waste sorting promotion.

3.3.2 Raise people's awareness

The promotion of waste separation policy requires the public as a target group to raise the awareness and knowledge level of participation in domestic waste separation. Education is an important way to raise the awareness of waste separation and an effective way to raise the level of people's cognition. In the daily education of schools, it is important to make waste separation a part of the school curriculum and cultivate students' awareness of waste separation in a subtle way. In daily work life, communities should pay attention to waste classification and guide residents to classify domestic waste by organizing various promotional activities. It is important to make people develop the habit of waste separation and make them realize the importance of waste separation to the environment and society.

3.3.3 Improve waste separation technology

Automatic waste sorting technology can be used to sort waste by image processing, taking an image and sorting it into four categories: paper, glass, metal and plastic. In addition to this, it is also possible to handle specified waste according to the type of waste, by using bar codes that will be sorted or sorted as waste[15]. This will reduce the environmental hazards caused by landfills and incineration.

In addition, anaerobic fermentation of food waste refers to the conversion of biodegradable organic matter in food waste into biogas, a renewable resource, in a closed reactor under anaerobic conditions with the action of parthenogenic and anaerobic microorganisms, thus realizing the reduction, harmlessness and resource utilization of solid organic waste. Biogas and biogas engineering can realize the recycling of agricultural and livestock breeding waste, which is an important link in the chain of plant production, animal transformation and microbial reduction.

4. Conclusions

Through research, this paper found that unsorted waste has a subtle negative impact on plant growth and its diversity. During the decomposition process of unsorted waste piles and landfills, heavy metals and other harmful substances in the waste can leach into the soil and have an impact on the growth and maintenance of plant diversity, and these various hazards are caused by unsorted waste, which can be explained by the following facts. First, people's awareness of waste separation and environmental protection is weak. For example, more people wrap their waste in plastic bags and throw it into the waste cans together to save time and convenience. Secondly, the waste sorting and disposal system is not perfect. For example, in order to efficiently dispose of waste, more landfills are used, thus polluting the environment. Thirdly, there is no corresponding penalty measure. Even if there is a corresponding policy of waste separation to promote the implementation of waste separation, it cannot drive all people to separate waste, and establishing corresponding penalty measures can make more people aware of the importance of waste separation. Three suggestions are made in this regard. First, strengthen the connection between the government and each subject, so that each subject has a clear division of labor and each of its responsibilities. Second, raise people's awareness of waste separation and environmental protection by means of publicity and education. Third, improve the technology of waste separation and to use the products of waste decomposition to the maximum extent, and to apply the products to industry or agriculture to achieve sustainable development.

This study firstly argues the impact of unsorted waste on plants, which facilitates an in-depth understanding of the background, causes and consequences that cause unsorted waste from three levels: government, people and organisms. As described in the research literature of this paper, different heavy metal elements in the soil have both synergistic and antagonistic effects on plants,

with moderate amounts promoting plant growth and excessive amounts potentially inhibiting it. Future data analysis can be further refined in the above description for further research on this topic.

References

[1] Yang Ting. Analysis of current situation and countermeasures of urban solid waste classification. Resource Conservation and Environmental Protection, 2020, (1): 142.

[2] Liu Qingjian. Why is it so difficult for China to implement waste classification? [J]. Ecological Economy, 2018(1)

[3] Geng Yanhu. Structural Dilemma of Urban Community waste Classification and its Breakthrough [J]. Journal of Nanjing University of Technology (Social Science Edition), 2014(3).

[4] Cheng Pengli, Hu Lei, Liu Yue, et al. Social work involved in the improvement of community residents' awareness of waste classification [J]. Journal of Chongqing University of Science and Technology (Social Science Edition), 2020, (5):29-32, 42.

[5] Xiao Lisheng, Zhang Guoqiang, Zhu Yong, et al. Promoting public participation in household waste management: A survey based method and case study in Xiamen City, China [J]. Journal of Cleaner Production, 2017, 144: 313-322.

[6] Sun Yucan, Yang Ting, Zhang Tao, et al. Analysis of residents' willingness to participate in waste classification in western China [J]. Environmental Sanitation Engineering, 2022, 30 (1):1-9, 16.

[7] Guo Jun.Treatment method of garden plant waste [J]. Ningxia agriculture and forestry science and technology, 2017, (5): 29,62.

[8] Li Shuqiao, Shao Guangya. The dilemma and path exploration of the promotion of municipal solid waste classification policy in China [J]. Guihai Review, 2021, 37 (5):95-100.

[9] Peng Xiao. Legal governance of urban solid waste classification [J]. Theoretical Circles,2014 (4) : 90-93.

[10] Wang Dandan. Research on Laws and policies of urban Solid waste Classification in China [J]. Journal of Taiyuan City Vocational and Technical College, 2021, (3):164-167.

[11] Dai Yu. Research on the causes and countermeasures of the difficulties in sorting urban Solid waste. Science and Information Technology, 2019, (26):198.

[12] Cudjoe Dan et al. Predicting waste sorting intention of residents of Jiangsu Province, China[J]. Journal of Cleaner Production, 2022, 366.

[13] Guo Xingli, Zuo Zhongshan, Sun Chao, et al. Effects of domestic waste recycling on Pb and Mn pollution in surrounding soil [J]. Science Technology and Engineering, 2018, Volume 18 (9):355-360.

[14] Xiong Minxian, Wu Di, Xu Xiangning et al. Research progress on toxic effects of soil heavy metal cadmium on higher plants [J]. Chinese Journal of Ecotoxicology, 2021, 16 (6):133-149.

[15] Faisal Alzyoud, Waleed Maqableh and Faiz Al Shrouf. A Semi Smart Adaptive Approach for Trash Classification[J]. INTERNATIONAL JOURNAL OF COMPUTERS COMMUNICATIONS & CONTROL, 2021, 16(4).