СОЦІАЛЬНА ТА ЕКОЛОГІЧНА ЕКОНОМІКА

ADVANCING WASTE MANAGEMENT PROGRAM AT UNIVERSITY IN CHINA: ENLIGHTENMENT FROM THE NETHERLANDS

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In the process of Green Campus Initiative in China, the lag of campus waste management program is the development bottleneck of many universities. To accelerate the implementation of the waste management program at university, this study conducted a case study to analyze the experience of Leiden University in waste management and the current situation of Henan Institute of Science and Technology's (H University) waste management program in China. Leiden University was chosen because of its outstanding performance in sustainability and its many similarities with H University. We attempted to provide a comprehensive overview of Leiden University's experiences from the perspectives of management includes its essential functions of planning, organizing, leading, and controlling. According to the problems existing in the waste management program of H University, some enlightenment could be drawn from the experience of Leiden University. We suggested that H University should formulate a top-level design on the waste management program, set up corresponding authority and responsibility institutions to involve all units and stakeholders in the waste management program by taking multiple measures, and establish innovative reward and punishment mechanisms and supervision mechanisms to stimulate the endogenous power of waste classification recycling. To accomplish waste management successfully rather than just stay at the theoretical level, this study puts forward specific and implementable waste management program for H University. Our findings are of great practical significance to the universities dedicated to waste classification and the municipal waste management system construction.
Key words: circular economy, green campus, sustainability, circularity, waste management.

Introduction. Adopting a circular and sustainable lifestyle is the crucial way for the public to contribute to the transition towards a circular economy (CE) model. As a kind of particular community with a large population, universities can provide conditions and environment to realize a sustainable lifestyle by bringing green campus plans into delivery and execution, which has always been a significant activity of education for sustainable development in various countries. In 2010, the United States established the Center for Green Campus and initiated the Green Campus Campaign. Meanwhile, the green campus evaluation system with Leadership in Energy & Environmental Design as the core was completed [1]. The European Foundation for Environmental Education (FEE) proposed a Green Campus Program in 1994, which has already become a worldwide program across Europe, Africa, South America, Asia, and Oceania. From its modest beginnings in a few European countries, the program has expanded to affect change in 56,000 schools in 70 countries across the globe up to now [2].

China first came up with the concept of green campus in 1996 [3]. In 2000, the Green Campus Guides was issued to emphasize the integration of environmental awareness and actions into the overall activities of the construction, management, and education on campus [4]. Subsequently, the Chinese Ministry of Housing and Urban-Rural Development compiled and issued the national standard Green Campus Evaluation Standards (GB/T51356-2019) in 2019 [5], which was taken as an evaluation basis for guiding the construction of green campuses includes primary and secondary schools, vocational schools and colleges. To promote the process of ecological civilization construction in the whole society, the Ministry of Education of China and the National Development and Reform Commission launched a nationwide Green Campus Construction Action Plan (GCCAP) in 2020, in which it stipulated the goal of achieving at least 60% of the green campus by 2022 [6]. However, the established green campuses are mainly primary and secondary schools as of now, while the process of green campus construction in universities is

relatively slow on the whole. Also, the construction progress of different universities is very different. It is of significant practical implication to help universities solve the difficulties and challenges in establishing green campus before the target deadline specified in the document.

Waste management program in universities has always been the considerable content and the primary indicator of green campus construction. In practice, waste classification recycling based on the CE principles is not only the primary development trend of the domestic waste management model but also the significant operation in the CE implementation [7]. Indeed, waste classification recycling is often regarded as a more explicit term for waste management. According to the GCCAP, the universal indicators for the evaluation of green campus include two specific hands related to waste management, namely, the situation of waste classification management and resource recycling and the status of establishment and improvement of waste classification management regulations. In 2018, the Chinese Ministry of Education and other five departments jointly issued a notice stipulating that universities should begin to explore the operation of domestic waste classification management on campus, with the goal of achieving a 100% penetration rate of waste classification knowledge by the end of 2020 [8]. In other words, the construction of the waste classification management system in Chinese universities is also still in its infancy.

As a kind of community in the society, universities must promote the waste management program on campus depending on the Municipal Solid Waste (MSW) management system, which is still under construction and has not yet formed a perfect mechanism in various Chinese cities. National policies do not yet impose mandatory measures on waste management at the whole social level. Therefore, the development of university waste management program is relatively backward, bringing about the phenomenon of 'concept recognition but action lag'. In 2019, China formulated its ambition to complete the domestic waste classification recycling system in 46 key cities by 2020 and in prefecture-level and above cities nationwide by 2025 [9]. Since then, various provinces and cities have begun to formulate or revise local domestic waste management regulations, which marks that China's waste classification management has gradually entered the mandatory era. It also means that the construction and development of the university waste management program will be on the right track. Therefore, exploring waste management strategies in universities is conducive to developing the whole social waste management system in the context of CE transition so as not to waste resources and destroy the environment.

Previous research shows that there is still a lack of scientific nature on university waste management model, collection scheme, and classification method, and the effect of classification and recycling is not satisfactory [10; 11]. For a latecomer in domestic garbage classification recycling like China, it is of great significance to learn from the experience and lessons of developed countries. The extant literature on the enlightenment of foreign waste management to China mainly includes four directions. The first is to independently introduce the waste management experience of a specific country [12; 13]. The second is to compare the practices and characteristics of waste management programs in several countries [14; 15]. The third is researching a particular step in the waste management process, such as waste disposal and regulatory system [16; 17]. The fourth is introducing the management experience of particular types of waste, such as plastic waste and construction waste [18; 19]. These studies provide many references for the improvement of waste management programs in China. However, there are few studies on the introduction of waste management experience in universities. Therefore, this study attempts to systematically review the waste management program of Leiden University, and then proposes the specific waste management program to practice on Chinese campus based on the analysis of the current situation of waste management at H University.

Materials and methods. To improve the performance of waste management programs in Chinese universities, this study attempts to describe the ideal shape of an effective university waste management program through a case study, thereby providing references for other universities struggling with waste management. In the course of the research, other research methods are also adopted. Firstly, we mainly adopt the literature method to review the waste management program of Leiden University, which is a leader in the construction of green universities, from the perspective of process management, trying to explore the standards of mature waste management system of universities. Then, observation and interview methods are used to understand the current problems of waste management at H University, thereby proposing the implementable waste management program for H University.

The waste management system of universities is a comprehensive management system that covers the whole process of the generation, classification, delivery, collection, transport, and disposal of all the waste on campus. To better understand and build the waste management system, we propose to analyze all the processes from the perspective of management functions. An integrated university waste management system should embody the essential functions of management, including planning, organizing, leading, and controlling. Planning refers to the orientation of the waste management goal and the accomplishing means. Organizing means the corresponding authority institutions and relevant responsible persons set up by universities to achieve the goal of waste management. Leading implies the publicity and education activities or incentive measures taken for the campus units or all teachers and students by the relevant responsible persons to realize the waste management goals. Controlling refers to the monitoring of waste classification activities on campus to correct deviations in time and take measures to ensure the plan's implementation. To assure the long-term and effective operation of the system, universities should fully consider all these factors in the management process.

To explore the standard process of waste management system in practice, this study selected the construction of the waste classification management system of Leiden

University in the Netherlands for a detailed review. The Netherlands was chosen as the target country because it is one of the first countries to separate waste and one of the best in implementation. Also, the Netherlands has the highest population density in Europe and one of the highest population densities of any country or region in the world. It means that the density of waste producers and throwers in the Netherlands is very high, which has similar problems with China, the most populous country in the world. Therefore, the practice of waste classification in Netherlands can provide valuable inspiration for the implementation of waste classification management in China.

In choosing the specific university, we considered the Netherlands universities in the UI GreenMetric World University Rankings (UIGWUR), which has been widely recognized as the most influential evaluation authority that aims to assess the sustainability performance of all universities around the world. A total of seven universities in Netherlands have participated in UIGWUR since 2017, but two universities dropped out of the rankings during the period (Table 1).

Wageningen University & Research has been ranked first in the rankings for the nearly 4 years. Nevertheless, we still chose to focus on Leiden University. Leiden University is currently the oldest continuously functioning university in the Netherlands, which is very aware of handling its responsibilities in the areas of sustainability and has achieved remarkable achievements in sustainable operations. In 2020, Leiden University was ranked 8th overall among all 911 participating universities in UIGWUR and 3rd among all participating universities in Netherlands. It is worth mentioning that this achievement of Leiden University is made in spite of its poor setting and infrastructure condition (ranked 629 in UIGWUR and 5th among Netherlandish universities). H University in China is similar to Leiden University in terms of setting and infrastructure conditions, such as insufficient open space area, campus forest cover

area, and limited budget for sustainability efforts. This is one of the main reasons why we chose Leiden University. In addition, after reviewing Leiden University's performance in sustainability, we found that Leiden University developed Environmental Policy Plan in 2015 and then became very active in sustainability in 2016. From 2017 to 2020, Leiden University's ranking in UIGWUR has steadily increased year by year. It is marvelous how much progress has taken place in such a short time. Therefore, Leiden University was chosen to provide references for Chinese universities to accelerate the process of sustainable development in the short term. The other thing we need to acknowledge is that Leiden University is very open about its sustainability activities, which demonstrates its ambition to be one of the most sustainable universities in the future and also gives us easy access to detailed information.

(a) Planning

From 2016 until the end of 2020, Leiden University had followed the Environmental Policy Plan 2016–2020 [21], which details how it intends to operate to take responsibility in the field of environment and sustainability, including integrating sustainability issues into the education and research, and clarifying waste accountability. The new 2030 vision for the sustainable development plan is delayed due to the impact of the corona-virus pandemic and is now being developed. The waste management program is one of the themes for improving the performance of the environment and sustainability in Leiden University's environmental policy plan. To reduce waste and increase the recycling of reusable resources, Leiden University takes a three-pronged approach to waste reduction that includes preventing waste, separating waste, and recycling. Among them, preventing waste is the main goal and the most effective approach to reducing the impact on the environment. Providing education in CE and sustainability for students, the primary waste producers, is conductive to achieve the goal. Therefore, Leiden University has developed some

Table 1 –The Netherlands universities that participated in UIGWUR from 2019–2020 [20]

The Netherlands universities In UIGWUR	Rankings	2017	2018	2019	2020
Wageningen University & Research	Overall Rankings	1	1	1	1
	Ranking by Waste	1	1	1	1
University of Groningen	Overall Rankings	11	7	8	7
	Ranking by Waste	17	34	5	5
Delft University of Technology Tu Delft	Overall Rankings	22	31	32	46
	Ranking by Waste	20	67	35	55
Leiden University	Overall Rankings	49	24	7	8
	Ranking by Waste	22	23	16	6
Eindhoven University of Technology	Overall Rankings	171	--	--	--
	Ranking by Waste	191	--	--	--
Radboud University	Overall Rankings	395	111	--	--
	Ranking by Waste	180	127	--	--
Tilburg University	Overall Rankings	410	464	139	221
	Ranking by Waste	168	258	166	242

ambitions of education and research so that students can learn more about CE and sustainable development during their studies, providing them with the knowledge and value they need to tackle the significant challenges in their future careers (Table 2).

In addition, while limiting the amount of waste as much as possible, universities need to sustainably dispose of any waste that is still generated so that raw materials can be recycled back into the supply chain to contribute to a CE. Sending remaining waste to waste-to-energy plants for incineration is the last way if there is no other option. Similarly, Leiden University's listed the ultimate goals of waste accountability in its environmental policy plan (Table 3). The first two goals correspond to the prong of preventing waste. The WAS1 and WAS2 are the goals of separating waste, and the last goal mainly depends on recycling activities.

(b) Organizing

All faculties and central services are involved in implementing the Environmental Policy Plan 2016–2020, which specifies the different responsibilities of departments and specialist centers for achieving individual goals. As for the goals in education and research, the responsibility for implementation lies mainly with the faculties and lecturers. The goals in the area of university operations will be achieved under the leadership of the Administration & Central Services Department and the expertise centers, in particular the Real Estate Directorate, the University

Services Department, and the Health, Safety & Environment Department (HSE). There are eight specific departments are participating in the general plan (Fig. 1). In the cloud map, the size of the keyword font represents the frequency of occurrence. That is, the department with larger font takes on more responsibility in practice. In terms of education and research, HSE and Administration & Central Services are responsible for the initiation of the related activities, especially the HSE.

It is essential to mention that the Green Office is responsible for coordinating and initiating the dynamic transformation process of all available resources on campus towards sustainable development in Leiden University, which was established by the HSE in 2016. The Green Office is committed to ensuring that Leiden University becomes more sustainable on all fronts, advancing waste classification management is one of its tasks. Indeed, the Green Office movement began in 2010 as an experiment at Maastricht University, and since then it has grown into an international movement involving large numbers of students and staff. The Green Office model initiated by RootAbility exists in six principles, including an operational team composed of students and staff, official mandate, resources for project implementation, integration with the organizational structure, collaboration with internal and external stakeholders, and professional competence training for members. The Green Office is part of the Administrative and central services of Leiden University and can be supported by the relevant

Table 2 – Action List of Education and Research in Leiden University from 2016 to 2020

No.	Goal	Responsible for initiation	When
EDU1	In 2018 there will be a clear overview of all the activities in the area of sustainability in teaching and research at Leiden University	HSE	2018
EDU2	In 2018 there will be a communications framework in which this overview can be presented and supplemented in a user-friendly way.	Communication	2018
EDU3	In 2018 the possibilities for including a compulsory general studies core curriculum course on sustainability in every bachelor's curriculum will have been investigated.	Centre for Sustainability	2018
EDU4	In 2018 the possibilities of a 'sustainability endorsement' on degree certificates will have been investigated.	Centre for Sustainability	2018
EDU5	From no later than 2018, the Centre for Sustainability will offer a course on 'integrating the theme of sustainability in existing curricula' for interested teaching staff.	Centre for Sustainability	2018
EDU6	No later than 2018, one or more workshops will be held in the Lorentz Center to explore how research in the area of the environment and sustainability can be developed further.	Lorentz Center	2016

Table 3 – List of Waste management goals in Leiden University from 2016 to 2020

No.	Goal	Responsible for initiation	When
WAS1	The external communication of the Administration & Central Services Department (BB) will be 95% digital, reducing its paper use by 40% compared with 2015.	Administration & Central Services	2017
WAS2	Each year the amount of waste per Leiden University student will be reduced, to a maximum of 25 kilos per student in 2020.	HSE	2020
WAS3	The amount of incinerated commercial waste will be less than 250 tons in 2020.	HSE	2020
WAS4	Collection points for plastic, paper and commercial waste will be installed in all University buildings (50 people or more).	HSE	2017
WAS5	From 2017, items that the University no longer needs will be offered to staff and students via a webshop.	HSE	2017

**Figure 1. Cloud map of the departments participating
in Environmental Policy Plan 2016–2020**

internal management and the dedicated advisory committee. Its main objective is to achieve structural sustainability in Leiden University's education, research and facilities, and foster a culture of sustainability on campus to make the university more sustainable.

(c) Leading

To achieve the goals of waste management, Leiden University has adopted a series of publicity and education activities and incentive measures for the campus units and all teachers and students. In terms of publicity and education, Leiden University has been working to raise awareness of environmental policies and measures among staff, students, and external stakeholders through communication activities. Communication takes place digitally through websites, social media, e-mail, blogs and vlogs, videos, apps, and narrowcasting. The Sustainable University is a separate archive on the university's website that maximizes access to environmental policy. In addition, the Green Office sets out Green Paper how universities can play a meaningful role in protecting a sustainable world through education, research, social impact, and their operations. Generally, the Green Paper is usually given away free to teachers, administrators, participating organizations, and interested residents.

In terms of specific activity implementation, Leiden University carries out many concrete activities in practice to ensure the performance of the three spearheads that include preventing waste, separating waste, and recycling in limiting the amount of waste. Concerning waste prevention, Leiden University has undertaken an active campaign to reduce paper use in Administrative & Central Services, and expects to gain experience for application to other departments. In fact, except for marketing and external communications, especially for student recruitment, where paper is still needed to produce brochures, internal communication in the campus's administrative offices is almost entirely via e-mail, websites, and social media to minimize paper use. Also, Leiden University regularly organizes knowledge and publicity activities to advise staff and students on how to prevent waste and to encourage them to participate in waste reduction initiatives.

As for the spearheads of separating waste and recycling, Leiden University pursues more refined waste classification

to limit the amount of waste, that is, to achieve maximum separation at source for better recycling efficiency and effectiveness. Since 2019, Leiden University has further refined the waste classification work to optimize the waste streams with the formation of five major waste streams, including paper and cardboard waste, organic waste and food waste, plastic packaging, metal and drinking cartons (PMD), coffee cups, and residual waste. Coffee cups were introduced as a new waste stream along with PMD recycling in 2019. By collecting coffee cups separately, the PMD stream is no longer contaminated, thus ensuring the desired purity. Meanwhile, there are some other separate waste streams collected on campus, such as wood, construction waste, glass, confidential documents, batteries, printer cartridges, and mobile phones. They are not a major waste stream, but these are also important factors in the recycling of reusable resources on campus. In addition to the residual waste cannot be recycled, the rest of the waste streams are ultimately directed to the recycling of separating resources. A recycling webshop has been set up to provide staff and students with second-hand commodities to promote reuse and reduce waste disposal costs. Also, Leiden University made deserted furniture available to student societies through the Green Office in 2020. Leiden University is mainly committed to reducing the generation of residual waste, while enhancing the degree of recycling of other recyclable waste.

(d) Controlling

Waste management at Leiden University complies with the provisions of the Environmental Management Act, the Environmental Permit, the Activities Act, and the National Waste Management Plan. In this case, fundamental principle of Lansink's ladder is applied in waste management program at Leiden University, which was put forward by the Dutch politician Ad Lansink in 1979. The Lansink's ladder principle was elevated to Dutch environmental law in 1994 and later adopted for the European Union in the 2008 Waste Framework Directive [22]. The priority of waste disposal has been stipulated in this acknowledged standard for waste management, namely prevention, preparing for reuse, recycling, other recovery, and disposal (Fig. 2). According to this waste hierarchy, preventing the waste generation is the best choice, while landfilling is the last resort when the

Figure 2. Waste hierarchy in the European Commission's Waste Framework Directive 2008/98/EC

current treatment methods are not appropriate. All waste must be sorted unless it is unreasonable.

It is naturally crucial to achieving these goals in the Environmental Policy Plan 2016–2020 with a transparent and structured manner. In this context, the administrative office of Leiden University is responsible for monitoring the plan implementation and maintaining contact with the relevant centers of expertise and coordinating activities. Also, the HSE is responsible for implementing the overall environmental policy plan. The primary way to make information available is through the Green Office website and the separate dossier named 'The sustainable university' on the university's new website. The electronic version of the Sustainability Report [23] is the most direct presentation of Leiden University's progress in sustainable development, including specific activities and projects in the areas of sustainable housing, energy, water, and the achievement of goals. The advancement in the waste management program is clearly shown in the Leiden University Sustainability Report 2020, as shown in Table 4. Some of the goals were not fully achieved due to the COVID-19 pandemic and the adjustment of relevant responsible departments. Still, the courage to disclose the data and admit its shortcomings also shows Leiden University's determination to strive for sustainable development.

Results. The establishment of a waste classification management system is a systematic project, involving planning, policy, organization, infrastructure, technology, supervision, and other aspects of work. With the promulgation of national and local waste classification management regulations in China, waste classification in universities is no longer a problem of policy and technology, but an issue of management. Therefore, to facilitate the progress of the waste management program in the Green Campus Initiative in China, it is necessary to analyze the difficulties existing in waste management in universities from the perspective of management. This study selects H University as the object, located in Xinxiang city, Henan province of central China. As a provincial undergraduate university, H University has a medium level of education and development scale nationally, so it is representative to conduct a case study.

Estimation of waste generation at H University

After confirming with the waste transportation company in H University, there are four waste trucks arranged for removal the campus waste four times every day, that is, a total of 16 trucks of waste are cleared out every day, each weighing about 650kg. To estimate the daily waste output per capita, we calculated the total population according to the number of permanent residents on campus, which is the sum of the number of full-time students on Xinxiang Campus

Table 4 – State of the waste management goals in the Environmental Policy Plan 2016–2020

Goals	Status	Responsible	When
WAS1	Not realized	Administrative office	2017
WAS2	Realized	University Facilities Company	2019
WAS3	Not realized	University Facilities Company	--
WAS4	Realized	University Facilities Company & Faculty of Mathematics and Natural Sciences	2017
WAS5	Ongoing	Health, Safety and Environment Department	Since 2019

Table 5 – Estimation parameters of waste output at H University

Number of waste trucks	Number of clearances per vehicle per day	Vehicle load (kg)	Number of permanent residents on campus	Daily waste output (kg)	Per capita daily output (kg)
4	4	650	26540	10400	0.39

(24202) and the number of resident staff and their families (2338) (Table 5).

The calculations are based on the daily waste output while the students are learning in school, not the data when students are absent during summer and winter vacations. If we consider the situation that the students spend 273 days in school excluding summer and winter vacations according to the university calendar, the average annual output per student is about 90.2kg. To understand the difference with foreign universities, this study selected some universities in the Netherlands for comparison. As shown in Table 6, the annual waste output per capita in H University is far more than that at the universities in Netherlands.

Table 6 – The per capita garbage output of some universities

Colleges and universities	Waste output per capita (kg)
H University	90 (per year)
Leiden University	31 (per year)
Utrecht University	55 (per year)
University of Groningen	29 (per year)
University of Amsterdam	29 (per year)

Source: the environmental coordinators of the universities concerned and the university website

Current state of Waste Management at H University

Although relevant national policy documents have stipulated that colleges and universities should set up specific waste management goals, specialized management organizations, incentive mechanisms, and safeguard measures, H University has not taken enough visible actions in these aspects for the time being. The property management division under the Logistics Management Department is mainly responsible for waste management in H University. There is not yet a particular organization to implement the waste management program and mobilize all faculty units and teachers and students to participate in the waste classification recycling. In the current waste management model, there are many problems in the measures of waste classification. For example, the waste classification standard in H University is still following the traditional dichotomy of recyclable waste and non-recyclable waste, which is inconsistent with the four major categories and 11 sub-categories in the national waste classification standard that includes Recyclable (paper, plastic, metal, glass, and textiles), Hazardous Waste (tubes, household chemicals, and batteries), Food Waste (Household food waste, restaurant food waste and other food waste), and Residual Waste. University is a special kind of community, so the waste sources on campus are similar to the origins of municipal solid waste. The direction of the waste streams on campus is bound to be connected with the municipal waste treatment process. Therefore, the difference in waste classification recycling between universities and cities will inevitably affect the effect and efficiency of waste management. Through a random selection of trash cans in different functional areas for inspection, we found that the correct classification of the waste on campus is insufficient, and the phenomenon of mixed waste dumping is quite common. In addition to the backward waste collection equipment, the lack of education, guidance, and supervision of waste classification behavior of students is also a significant factor for this phenomenon. Besides, the designated waste collection company in H University has always mixed all waste in different trash bins and then transported them to the transfer station for uniform classification. Mixed collection and transportation not only mean the classification behaviors in the dumping process is meaningless but also will lead to secondary pollution, resulting in lower recycling efficiency and higher labor costs.

On a positive note, the kitchen waste in campus restaurants is uniformly recycled by the company designated
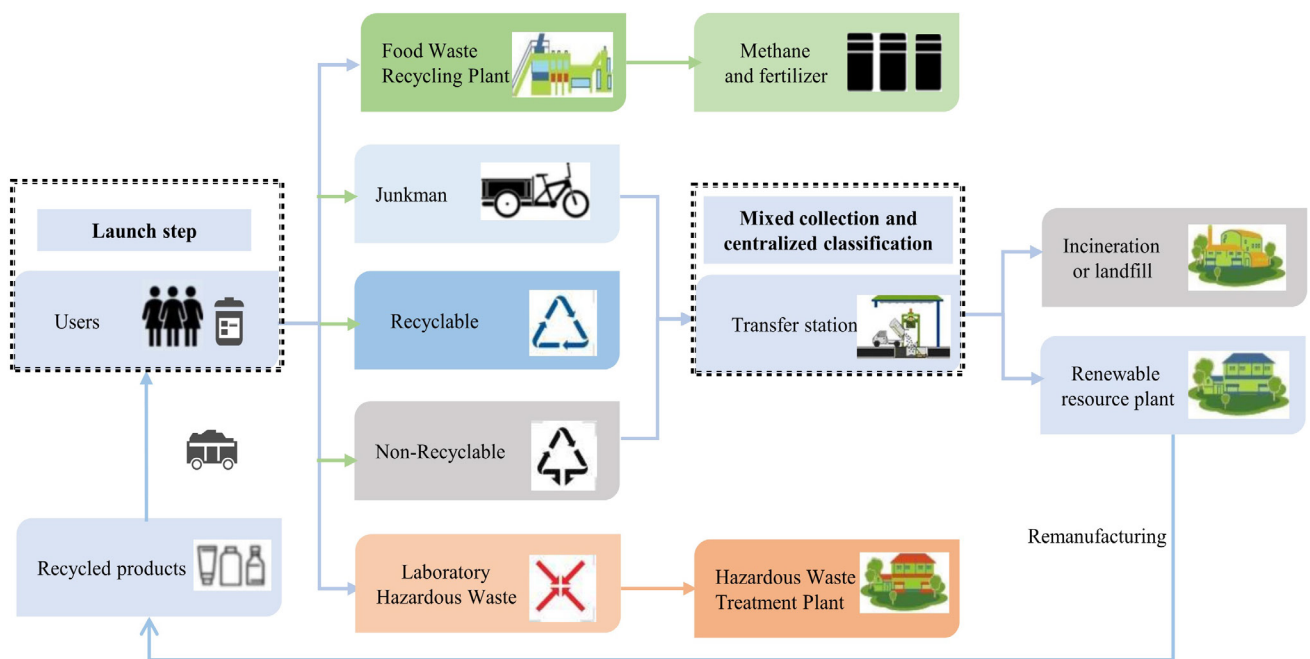

Figure 3. Waste streams collected at H University

by the urban market supervision department for biological fermentation treatment. The hazardous waste produced by the laboratories is also disposed of by a particular outsourcing company designated by H University. In addition, campus junkmen have contributed to waste classification recycling to a certain extent, admittedly, although they have brought inconvenience to campus management. They mainly collect uncontaminated cardboard, plastic bottles, books, and other highly remunerative waste to resell it to waste transfer stations, which protects the value of some recyclable materials and avoids the material contamination caused by mixed collection. The waste streams collected on campus reveal that H University only acts as an intermediary coordinator in waste classification management to transfer waste management services to other enterprises through contract outsourcing (Fig. 3). As a matter of fact, universities should take more responsibility for waste classification management as administrators and leaders of sustainable development on campus.

Discussion. Waste classification recycling on campus is the leading way for universities to contribute to waste reduction and resource recovery. To get rid of the complex predicament of waste classification on campus, the construction of the waste classification management system is particularly significant. Universities that have pioneered and developed waste classification management systems could provide enlightenment for the universities that are about to take relevant action. Therefore, H University should take inspiration from Leiden University's model in implementing the waste management program on campus.

First of all, H University could accomplish top-level design to put waste management program into the CE framework and green campus system. The overall planning and scheme formulation of the waste management program should involve all departments and all university personnel. On the one hand, H University should explore the establishment and improvement of waste classification regulations, standardize the whole process of waste stream on campus, including waste category definition, classification dumping, classification collection, classification transportation, and classification treatment. Also, it is necessary to straighten out the responsibilities and obligations of staff and students in campus waste classification. On the other hand, H universities should carry out regional governance according to different functional areas on campus. On the premise of overall planning, appropriate fine-tuning can be carried out based on the actual situation to improve the campus waste classification program continuously. Meanwhile, it is necessary to set up corresponding authority and responsibility institutions and relevant responsible persons in H University to achieve the goal of the waste management program. The organizational mechanism should be an organizational structure with different levels from top to bottom to promote all units and stakeholders in universities to participate in the waste classification recycling activities.

Moreover, university staff and students are the primary consumers and users of resources on campus. If they are unaware of the significance of waste classification recycling and the measures that have been implemented on campus, it will directly lead to the demise of the university waste management program. Therefore, H University should popularize the knowledge and value of waste classification widely through publicity and education, and gather the executive power of waste classification from the public. The advantages of teaching resources in colleges and universities could be exerted to integrate the waste management program into the construction of university spirit, teaching spirit, and learning spirit by taking advantage of the curriculum instruction and extra-curricular education. Also, H University should carry out different forms of waste classification publicity and education activities according to different groups to gradually cultivate the awareness and behavior. It should be used to explore the establishment of intelligent waste classification applet could be established based on the campus's new media platform to assist waste classification management. Besides, the completeness of waste classification facilities directly determines the process of waste classification. H University should improve waste classification equipment and infrastructure in combination with the overall plan of waste classification management. Also, it is essential to arrange the waste dumping points and cleaning frequency according to different regions so that waste bins be cleaned up timely to avoid polluting the campus environment and improve the efficiency of waste removal [24].

Finally, it is necessary to expand the public participation in waste classification on campus to stimulate the internal power of waste classification by establishing appropriate reward and punishment mechanisms and supervision mechanisms. Both education and coercion are indispensable. The majority of staff and students should recognize the benefits and rewards of waste classification, and also realize the penalty for not carrying out waste classification activities. If waste classification behaviors could bring not only the intrinsic motivation such as pleasure, but also external motivation such as respect and praise from others and material reward, people's personal initiative will be naturally strengthened. Meanwhile, different forms of punishment for not classifying waste or failing to classify waste correctly can also produce adverse reinforcement effects. Supervision mechanisms are indispensable to the implementation of the waste management program on campus. H University should disclose the waste management work plan, relevant activities, and target realization to both inside and outside the university in accordance with regulations, and consciously accept the supervision of staff and students inside the university, as well as all walks of life in society.

To accomplish waste management successfully rather than just stay at the theoretical level, this study puts forward the project of waste management program at H University to promote the implementation of waste classification recycling on campus.

Simplified project of "Waste Management Program at Henan Institute of Science and Technology" is provided bellow.

1. Introduction
1.2 Purpose and Background

H University Logistics Management Department has developed this Program to establish standard procedures for the management of wastes generated on campus in accordance with all local and national regulations. These regulations include but are not limited to the government laws and the university stipulations. The purpose of this Program is to protect human health, the environment, and the depletable resources by preventing the release of contaminants through sound, best management practices for waste generation, handling and disposal.

1.3 Scope

This Program applies to all permanent residents and migrants of H University that include but are not limited to the students, faculty, staff, management, and campus visitors.

The waste in this Program refers to all kind of surplus material generated by the H University community in any activity on campus, which includes but is not limited to laboratory research, maintenance, site maintenance, academic instruction, and restaurant service. Waste classification on campus is consistent with the national standards (GB/T 19095-2019), including four categories and 11 sub-categories.

1.4 Principles

The aim of waste management is to maximum improve the recycling efficiency of reusable resources and minimum reduce the quantity of waste going to landfills in accordance with waste hierarchy management. Waste must be treated as a resource and the only waste that should be sent to landfill is the ultimate waste that cannot be reused, recycled or composted. Waste management follows mainly the 3R principle (Reduce, Reuse, Recycle), in which Reduce is the top priority in waste disposal.

– Reduce: where applicable, H University should endeavor to reduce the consumption of materials that generate waste;

– Reuse: where necessary, H University should redistribute surplus materials within the community for reuse;

– Recycle: where necessary, H University should aim at recovering materials that are no longer usable.

2. Organization and Responsibility

To strengthen scientific management in waste classification, the campus waste classification management leading group has been established as the routine proceeding organ with the university rector as the leader, the vice-rectors who are in charge of administrative work, comprehensive management, student work, personnel work, and logistics work as the deputy leader, and the prominent leaders of Logistics Management Department and secondary faculties as members. The specific work is mainly responsible for various specialized offices or groups under it, including unifying and standardizing the campus waste classification management and mobilizing the functional departments, teachers and students to participate in the waste classification recycling actively, see Fig. 4.

2.1. H University Waste classification management leading group is responsible for:

– Formulating policies for waste classification management;

– Making overall planning and scheme of the Waste Management Program;

– Evaluating and developing the Waste Management Program;

– Forming and reporting on the annual performance of campus waste management;

– Raising funds for Waste Management Program.

2.2. Logistics Management Departments are responsible for:

– Promoting the implementation of the Waste Management Program on campus;

– Providing annual training and/or technical guidance on waste management requirements and procedures to all affected employees;

– Maintaining waste contracts with all the waste recycling and transport companies;

– Facilitating waste minimization efforts with adequate and practical manners;

– Taking effective measures to involve all teachers, students and staff actively participate in waste classification activities;

2.3. Sub-group and relevant sections are responsible for:

– Ensuring employees and students are properly instructed in the requirements of this program;

– Ensuring standard operating procedures based on this Program are developed for waste management, waste minimization, and handling emergencies;

– Ensuring that all employees who handle waste receive initial waste management training in waste management

Figure 4. Organization structure of waste classification management at H University

procedures as well as annual refresher training if required by this Program;

– Ensuring employees and students who fail to follow the Program are retrained and educated;

– Enforcing Program requirements within their areas of responsibility.

2.4. Employees and students are responsible for:

– Learning and following Waste Management Program requirements for comprehensive waste management;

– Participating in training and education in waste separation and disposal;

– Assuming personal responsibility for compliant identification, storage, dumping, and disposal of all wastes generated as a result of his or her any activities;

– Developing and implementing waste reduction measures whenever feasible.

3. Ambitions and implementation

H University will take a three-pronged approach to waste reduction within the priorities, which includes preventing waste generation, strengthening front-end waste classification, and improving back-end recycling. The Logistics Management Department and various faculties will develop the following list of orientations within the next five years through the cooperation with all units at H University.

3.1 Orientation of preventing waste

– Replacing paper for office and meeting documents with electronic files in administrative departments;

– Replacing the paper and pen examination with computer examination for students in some appropriate subjects to reduce plenty of paper waste;

– Promoting reusable cups and cutlery instead of disposable tableware;

– Encouraging the donation of used clothing to reduce the amount of waste;

– Advocating buying meals on demand at restaurants to avoid food waste;

– Offering elective courses related to waste management or resource recycling;

– Integrating the idle bicycles on campus to construct a shared cycling system;

– Constructing an internet second-hand book trading platform.

3.2 Orientation of front-end waste classification

– Replacing the outdated waste collection facilities with those in line with unified national standards;

– Allocating appropriate classification trash bins reasonably according to the different functional areas on campus that generate different category of waste;

– Collecting some particular categories of waste, such as cardboard and plastic bottles, in dedicated waste streams to increase the recovery efficiency;

– Organizing waste classification knowledge contests and/or speech competitions to promote the knowledge of waste classification;

– Setting up particular work-study positions for students to guide and supervise waste classification;

– Encouraging students to set up organizations and associations for promoting waste classification on campus;

– Evaluating and rewarding excellent individuals and units in waste classification.

– Cooperating with on-campus businesses to encouraging the waste classification behaviors with discounts on their mobile phone bills or benefit rewards in nearby convenience store.

3.3 Orientation of back-end waste recycling

– Pulverizing the garden waste and making it into fertilizer by fermentation;

– Making the food waste into organic fertilizer by fermentation;

– Setting up semi-closed waste classification transfer center on campus for carry out secondary classification to avoid mixed collection;

– Cooperating with qualified resource utilization and terminal disposal enterprises to take harmless treatment for wastes that cannot be realized recovery on campus.

4. Supervision and guarantees

During the implementation of this Program, H University will exercise the following supervisory measures to guarantee the performance of waste management.

– Announcing the waste management work plan and overall schedule on the university website;

– Presenting the annual report on waste management that includes the actions taken and goals achieved to accept the supervision of staff and students, as well as all walks of life in society;

– Incorporating the progress of waste management program in all faculties and departments into the annual assessment.

Conclusions. An important step towards sustainability in university waste management is to consider a university as a distinct urban mine [25]. A university can be viewed as an ordinary small city, in which staff and students are the consumers of resources and commodities. The implementation of waste management programs in universities is of great practical significance to the C and the construction of municipal waste management system. From the perspective of management, this study analyzed the experience of Leiden University in waste management and the problems existing in the waste management program of H University in China. Leiden university's waste management plan and goals are set out in its environmental policy plan, which elaborates on how it intends to operate to meet its responsibilities in the area of environment and sustainability. We listed the specific goals, responsible departments, and implementation status of the accountabilities of the fields of education and research and waste. To achieve the waste management goals, Leiden University has adopted a three-pronged approach to reduce waste, including preventing waste, separating waste, and recycling. The annual sustainability report is an effective way to demonstrate the effectiveness of waste management and the university's continuous commitment to sustainable development.

Moreover, we found that H University had some problems in waste management program, such as lack of plans and related organizations, lagging waste classification standards and equipment, low degree of waste classification recycling, insufficient waste classification education and

publicity, and lack of control and supervision measures. The findings show that H University could get the following enlightenment from Leiden University regarding waste management. H University should accomplish top-level design on the waste management program which involves clear plans, goals, and schedules. Also, it is necessary to set up corresponding authority and responsibility institutions to promote all units and stakeholders in H University to participate in the waste management program by taking multiple measures of publicity and education. Furthermore, H University should establish innovative reward and punishment mechanisms and supervision mechanisms to stimulate the endogenous power of waste classification recycling. To accomplish waste management successfully, this study attempts to propose the specific waste management program for H University. The problems in waste management at H University are representative in China, so our findings can provide a reference for the universities with similar situations.

We acknowledge it is not easy to achieve waste classification in large communities with huge populations like universities. H University could also be innovative in applying new scientific technology to the waste management program. For example, with the development of artificial intelligence technology in waste management, the artificial intelligence waste classification recycling bins can realize real-name waste dumping, entire category waste collection, and intelligent supervision. The users' identity could be confirmed by campus card or facial recognition when they dumping waste. After they finish dumping waste, their mobile App will receive voice and message prompts for correct or incorrect classification. Users are rewarded with electronic points that can be redeemed for daily necessities if they correctly dump their waste in the appropriate bin. Or, the trash can estimate the probability of the users' error by analyzing past dumping behavior with an algorithm when they make a mistake, and then decide whether to deduct the user's personal credit score or retrain the user with waste classification knowledge. Therefore, how to guide and supervise waste classification behaviors effectively with the assistance of artificial intelligence technology could be focused on in the future research.

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РОЗРОБЛЕННЯ ПРОГРАМ ПОВОДЖЕННЯ З ВІДХОДАМИ В УНІВЕРСИТЕТАХ КИТАЮ НА ОСНОВІ ДОСВІДУ НІДЕРЛАНДІВ

Стаття спрямована на пошук можливостей розвитку системи поводження з відходами у Хенанському університеті науки і технологій на основі вивчення відповідного досвіду університетів Нідерландів, що відносяться до числа прогресивних згідно UI GreenMetric World University Rankings. У дослідженні викладено результати вивчення досвіду Лейденського університету та представлено проект програми поводження з відходами для Хенанського університету науки і технологій.

Ключові слова: *циркулярна економіка, зелений кампус, сталий розвиток, поводження з відходами.*