



# Integrating Environmental Protection and Sustainable Waste Practices Among the Communities in Higher Education Institutions: Case Study in a Malaysian University

Siok Sin Chan<sup>1</sup>, Theam Foo Ng<sup>1\*</sup>, Mohd Sayuti Hassan<sup>1</sup>, Chee Keat Ying<sup>2</sup>, Mei Lan Tan<sup>3</sup>, Siti Fairuz Mohd Radzi<sup>1</sup>, Reem Abou Assi<sup>4,5</sup> and Siok-Yee Chan<sup>1,4\*</sup>

<sup>1</sup>Centre for Global Sustainability Studies, Universiti Sains Malaysia, Gelugor, Malaysia, <sup>2</sup>Department of Biomedical Imaging, Advanced Medical and Dental Institute, Universiti Sains Malaysia, Bertam, Malaysia, <sup>3</sup>School of Pharmaceutical Sciences, Universiti Sains Malaysia, Gelugor, Malaysia, <sup>4</sup>Thoughts Formulation Laboratory, Discipline of Pharmaceutical Technology, School of Pharmaceutical Sciences, Universiti Sains Malaysia, Gelugor, Malaysia, <sup>5</sup>EDEN Research Group, College of Pharmacy, Al-Kitab University, Kirkuk, Iraq

## OPEN ACCESS

### Edited by:

Diogo Guedes Vidal,  
University of Coimbra, Portugal

### Reviewed by:

Gazi Alam,  
Putra Malaysia University, Malaysia  
Zujaja Wahaj,  
National University of Sciences and  
Technology (NUST), Pakistan

### \*Correspondence:

Theam Foo Ng  
tfng@usm.my  
Siok-Yee Chan  
sychan@usm.my

### Specialty section:

This article was submitted to  
Environmental Economics and  
Management,  
a section of the journal  
Frontiers in Environmental Science

Received: 28 February 2022

Accepted: 19 April 2022

Published: 17 May 2022

### Citation:

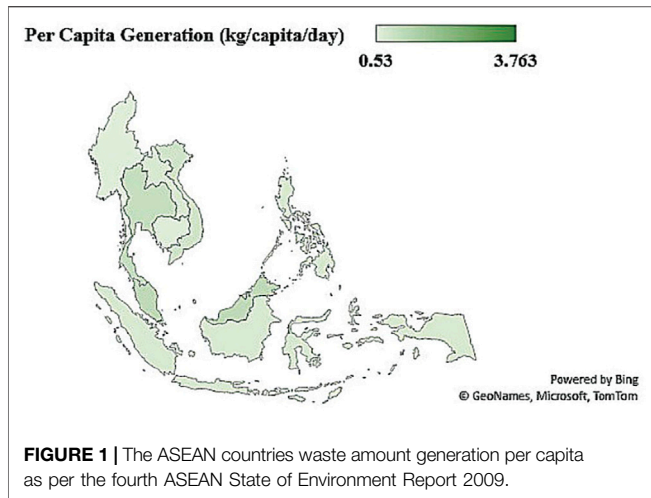
Chan SS, Ng TF, Hassan MS, Ying CK,  
Tan ML, Mohd Radzi SF, Abou Assi R  
and Chan S-Y (2022) Integrating  
Environmental Protection and  
Sustainable Waste Practices Among  
the Communities in Higher Education  
Institutions: Case Study in a  
Malaysian University.  
Front. Environ. Sci. 10:886060.  
doi: 10.3389/fenvs.2022.886060

This work is reporting the advocacy of a public Malaysia University for the environmental protection through sustainable waste practices ever since its ban on the use of the “White Coffin” initiative in circa 2008, a flagship for environmental activism on its different campuses targeting to get rid of polystyrene containers. This initiative was not halted but served as a spark of flare for a sustainability journey up to this very day. The effort to realise a sustainable tomorrow as the vision of higher education sector, including the studied Malaysian University has been integrating efforts from various parties. This includes the formation of “Kampus Sejahtera” (wellness campus), regional centre of expertise, sustainability course, and more recently the sustainability month, sustainability network, and most importantly, the local NGO-industrial-academia collaboration in the path toward a sustainable tomorrow. The work in this article delineates a case study in implementing sustainable waste practice from the start to the status, in one of the Malaysian public universities which is ranked 39th in Times Higher Education University in Global Impact Ranking 2021, and top in Malaysia. More emphasis will be placed on the current initiative of the local NGO-industrial-academia collaboration as case study in the midst of the COVID-19 pandemic.

**Keywords:** waste, sustainability, higher education institute, practice, sdg

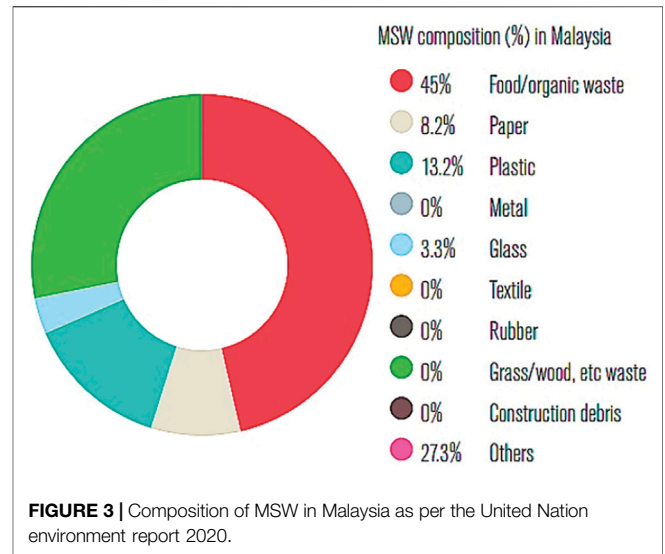
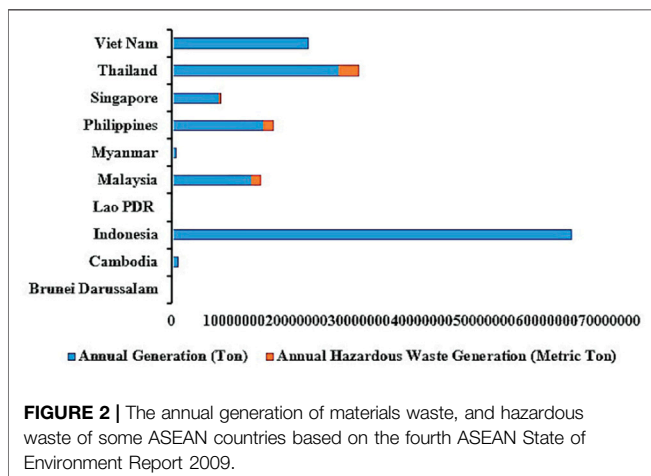
## 1 INTRODUCTION

Humanity’s relationship with the natural world is currently facing a critical challenge. Overuse of the earth’s resources, greenhouse gas emissions and other forms of pollution, and biodiversity loss pose severe threats to survival and quality of life (Edwin et al., 2021). As a result, climate change has emerged as one of the 21st century’s most contentious global environmental issues. To address this issue, academia is currently focusing on the role of cities and their associated activities, which include the release of harmful substances such as municipal solid waste (MSW), carbon dioxide, and greenhouse gases (Onyanta, 2016), MSW is an inevitable consequence of human activity, in fact



“waste” concept in nature does not exist, as nature is capable of “recycling” the elements in the ecosystem. Precisely, MSW is a collection of various solid wastes generated by towns and cities from various types of households, businesses and institutional activities (Niazi et al., 2016).

MSW remains an alarming global problem, particularly in cities that lack regulatory oversight, and while the consumerism and convenience associated with a buy-use-dispose system, resource consumption is accelerating, most developing countries are currently experiencing an increase in a waste generation. As a result, a large amount of MSW has been discarded into the landfills (Ngoc and Schnitzer, 2009). The accumulation of waste in specific locations has resulted from waste generation that has exceeded the earth’s carrying capacity by more than 30% (Periathamby et al., 2011). Based on the World Bank Group estimations, such kinds of wastes generation will grow from annual generation of 2.01 billion tonnes to 3.40 billion tonnes by 2050, which equals more than double population growth over the same period (Group, 2018). The vital waste collection rates vary significantly and proportionally related to the income level, where high-income countries produce less food



and green waste and more dry waste that could be recycled, whereas middle- and low-income countries generate 53% and 57% of food waste and of green waste, respectively (Group, 2018).

Based on the fourth ASEAN State of Environment Report 2009, and among the ASEAN countries Singapore, Brunei, Malaysia, and Thailand have the highest waste amount generation per capita respectively (Ngoc and Schnitzer, 2009), as illustrated in **Figure 1**. Indeed, the annual generation of materials waste, and hazardous waste is relatively alarming, even though such data is limited in some countries, as shown in **Figure 2**.

Precisely, in Malaysia, many factors contribute to such waste generation, including urban migration, affluence, and rapid development. Composition of MSW in Malaysia as one of the ASEAN Countries is illustrated in **Figure 3** as per the United Nation environment summery report: waste management in ASEAN countries, 2020 (Nation, 2020).

Moreover, the Malaysian government, through the Department of Environment, has developed its vision of achieving a higher level of health, safety, and living standards through preservation and conservation efforts, pollution prevention and control, as well as protecting the integrity of wise use of natural resources toward sustainable development for the current and coming generations (Dawda Badgie et al., 2012).

The National Solid Waste Management Policy aims to create a management system that is holistic, integrated, cost-effective, and long-term, as well as publicly acceptable. (NEGARA et al., 2013). In Penang state, the state government promotes recyclable markets through 3Rs (reduce, reuse, recycle) and awareness-raising campaigns and provides information about where citizens can deposit recyclables through a think-tank called Penang Green Council. Furthermore, community-based organizations and non-governmental organizations were involved in climate change issues to a lesser extent than those in Kuala Lumpur. Still, civil society (including business representatives) was critical to advancing recycling and composting initiatives across the state. As a result, there is

now a thriving private sector in the recycling industry and business; thus, Penang is estimated to have a recycling rate of 30%, possibly the highest in Malaysia. However, Penang's estimates were based on recycling company reports to the local authorities as there were no official numbers for recycling rates in Malaysia (Puppim de Oliveira, 2019).

Addressing waste management (WM) is gradually being recognized as a “basic human right” (Wilson et al., 2013), where such management involves the public and is heavily influenced by societal and socioeconomic drivers (Periathamby et al., 2011). This growing demand is linked to at least 12 of the 17 Sustainable Development Goals (SDGs) (Wilson et al., 2013; Rodić and Wilson, 2017), which is a fundamental concept in the 2030 Agenda, particularly the sustainable cities and communities (SDG 11), the responsible consumption and production (SDG 12), and life below water (SDG 14) (Nations, 2015), as well as the responsible chemical and waste management as per the Stockholm Environment Institute's most recent report, commissioned by the European Environment Agency (Weitz, 2019). Interestingly, while the COVID-19 pandemic is seen to have reduced air pollution and environmental noise, as well as improved biodiversity and tourist sites, the impact of stay-at-home and preventive measures on waste management concerns, with increased waste production from both households and health facilities, as well as reduced waste collection and recycling due to lockdowns is negative; as a result, waste management is now a more censorious public service and practice than ever before (Tripathi et al., 2020; Sarkodie and Owusu, 2021).

According to UNESCO, education is one of the essential tools for raising environmental awareness among people, particularly in developing countries. Environmental education effectively closes the reported knowledge gap between young and old in waste management segregation and waste sustainability (Singhirunnusorn et al., 2017; UNESCO et al., 2018). Furthermore, the United States Environmental Protection Agency (EPA) considers environmental education to include more than just environmental information. It instead improves critical thinking, aiding in problem-solving and allowing for effective decision-making (Agency—USA and E.P., 2018). Unfortunately, while there are many examples of positive contributions, universities can be hampered by competing priorities, poor coordination, and a lack of resources, among other things (Edwin et al., 2021).

Policymakers use behavioural research to create interventions that encourage society's voluntary adoption of long-term environmental behaviour (Moore and Boldero, 2017). Several studies have focused on human behavioural understanding and its application to various environmental issues, including waste management. Still, the relative importance of such knowledge shall be explored specific to the cultural practices across all higher education sectors, so raising knowledge, awareness, and motivation for new standard sustainable practices is a leading action toward waste management (Zurbrugg and Ahmed, 1999; Desa et al., 2011; Desa et al., 2012; Licy, 2013; Babaei et al., 2015; Janmaimool, 2017; Nguyen and Watanabe, 2020). The same holds true for establishing effective practices in the higher

**TABLE 1** | The questions raised by this work.

No.	The question
1	Does the public Malaysia University practice environmental protection?
2	What are the initiatives taken by university to promote sustainability and sustainable waste practices?
3	How effective of integrating various parties' efforts to implement sustainability in university campus?

education sectors (Giusti, 2009; Ifegbesan, 2010; Meidiana and Gamse, 2010; Aleluia and Ferrão, 2016). Having faculty members who behave sustainably on campus is the ultimate goal of higher education institutions, but it remains challenging. In this article, the journey of establishing sustainability practices will be described. The focus will be paid to the successful recent initiative on solid waste management using an education framework.

## 2 RESEARCH AIMS, OBJECTIVES AND QUESTIONS

Higher education and research are inextricably linked, as one cannot exist without the other. In fact, the modern higher education has a significant impact on the economy as a whole, with the primary goal of developing job-ready graduates that are also ready for tomorrow's challenges, i.e., waste management. The contribution of higher education to preparing job-ready graduates is used to assess the performance of education for sustainable development (Alam et al., 2021).

Universities are attempting to become as centres of innovation and invention, focusing on “sustainable development” (i.e., climate change, disaster management, solar energy, waste management). This effort must ensure that well-timed, environmentally responsible breakthroughs enable significant industrial growth and development (Alam et al., 2020). Hence, questions asked by this work are illustrated in **Table 1**. Besides, the objectives of this case study investigation are to: (i) to explore how the Malaysian University in promoting environmental protection and sustainability, (ii) to show case practical initiatives and programs to implement sustainability model, (iii) to suggest the concepts and practical of implementing waste management effectively.

## 3 THE JOURNEY OF SUSTAINABILITY AT STUDIED INSTITUTE

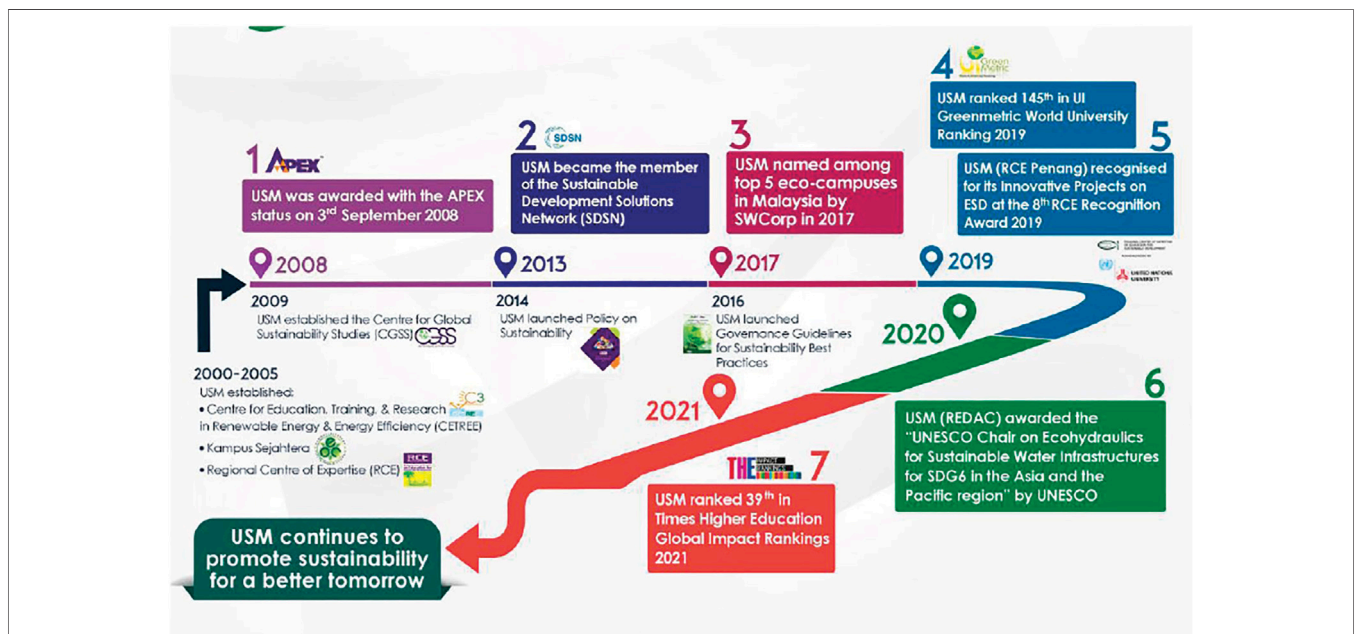
Since 2000, the investigated Malaysian university has been incorporating sustainability components into its ecosphere by embodying the environmental protection, resources conservation, and sustainable revolution measures into its curriculum and campuses life. As a result of this practice, the university was awarded the Malaysian Ministry of Higher Education's Accelerated Programme for Excellence (APEX) certification in 2008.

**TABLE 2 |** Example of research question pertaining to waste management carried out by undergraduate students from the course of WSU 101.

Example of research question	Mean score
I will always use old papers that have been used before to write/print rather than new blank papers?	3.87 ± 0.98 (n = 169)
I reuse notes and textbooks rather than buying a new one	3.93 ± 0.95 (n = 169)
I print my documents double sided/multiple pages in a single sheet of paper.	4.27 ± 0.94 (n = 169)
As a USM community, do you think USM is currently toward paper "less" status?	3.96 ± 1.09 (n = 169)
Do you support if USM promote and practice 3R, i.e. reduce, reuse, recycle?	4.51 ± 0.74 (n = 58)
We are responsible for a healthier environment.	4.67 ± 0.62 (n = 100)
We can save our environment by practicing 3R in our daily live.	4.50 ± 0.77 (n = 100)
What do you think about having plastic banned in USM?	3.96 ± 0.85 (n = 100)
Would you agree to make the switch from plastic to other alternatives such as eco-friendly container?	4.41 ± 0.73 (n = 100)

The studied public Malaysian university has established several sustainability-related programmes to address issues environmental challenges and prepare its graduates community and members of the public with sustainability knowledge and awareness. The Centre for Global Sustainability Studies (CGSS) and the University Sustainability Council (USC) have been initiated to assist the university to mainstreaming and integrating sustainability elements and addressing related concerns. The university’s sustainability activities have also helped it rank among the top universities in many prestigious global sustainability rankings. **Figure 4** depicts the overview of the sustainability journey of the university throughout the years. The case studied university has established its sustainability model to further improve the integration process of sustainability inside the university ecosphere as a university that has promoted sustainability as one of its thrusts since its founding. It combines the five primary sectors promoted by the United Nations, known as Water,

Energy, Health, Agriculture, and Biodiversity (WEHAB), with three additional cross-sectoral categories introduced by the university: Climate Change/Disaster Risk Management, Population/Poverty, and Production/Consumption. In addition, other pertaining pillars of sustainability, such as society, the economy, the environment, and the university’s three main domain namely teaching, research, and community, are also incorporated to ensure that all aspects of sustainability are embedded to achieve the sustainability aspiration. Moreover, the model allows all university’s faculty and staff, including academic and administrative, to participate and engage in implementing sustainable programmes (Corcoran et al., 2012). The model was updated in 2015 to consider the United Nations’ Sustainable Development Goals (SDGs). Since then, it has served as a focal reference for CGSS and other relevant departments in university to launch that aligns with the university’s sustainability model and vision; “Transforming Higher Education for a Sustainable Tomorrow”. The said



**FIGURE 4 |** The sustainability journey in a public Malaysian university.



model encompasses six core elements, i.e., 1) Kampus Sejahtera (Wellness Campus), 2) Regional centre of expertise, 3) Sustainability course, 4) Sustainability month, 5) Sustainability network, and most importantly, 6) Waste management through NGO-industrial-academic collaboration in the effort of implanting the sustainability mindset among the community within and around the university. The following sections will go through each component of the sustainability model in further detail.

### 3.1 Kampus Sejahtera

Universities are regarded as the appropriate avenue to create and train future leaders with suitable knowledge in sustainability issues and can use sustainable development to improve society, the economy, and the environment through sustainable development (Herzner and Stucken, 2020; Ribeiro, 2021). Therefore, the studied public university has created a student-led group known as the Agent of Change, which has served as a conduit for spreading along with the Kampus Sejahtera group, which is literally translated to “Healthy Campus,” in English was founded in 2001, both initiatives aim to promote sustainability awareness among students. As a result, the university believed that empowering students to engage sustainability awareness among their peers was significantly more effective than using the conventional method as people are easily influenced by their peers (Manca et al., 2020).

Volunteerism, teamwork, data and information, self-sufficiency, and comprehensive documentations were the foundations of Kampus Sejahtera (Corcoran et al., 2012). Since Kampus Sejahtera is a student-led group, all sustainability programmes are tailored to the requirements of students and the community outside the university. Furthermore, another most successful programmes is the *White Coffin* campaign, which was initiated in 2008, in attempt to raise awareness among the community inside and outside of the campus concerning the use of polystyrene and single-use plastic products that can cause cancer in the long term (Nik Khusairi Ibrahim, 2008; USM and S., 2008). The effort was effective in outlawing the use of Styrofoam containers on the university's campuses and at all campus-hosted events. The factor of the institute's different bodies cooperation (i.e, top management, personnel, and cafeteria operators) was significant to such success. The initiative was then replicated in six universities in Malaysia and received a globally acclaimed award from the Global Network for Innovation in Spain in 2010 (Razak, 2010).

### 3.2 Regional Centre of Expertise

The United Nations developed a global network, the Regional Centre of Expertise (RCE), in 2005, with global multi-stakeholders to support the Decade Education for Sustainable Development by embedding sustainability elements into existing education on the global scale. In 2005, the studied case university was designated as the Malaysian host institution (RCE-Penang@USM) for one of the world's 127 RCEs based globally. Initially, RCE, was founded to connect the host institution with other relevant stakeholders nationally and internationally to promote education for sustainable development (ESD) at the community

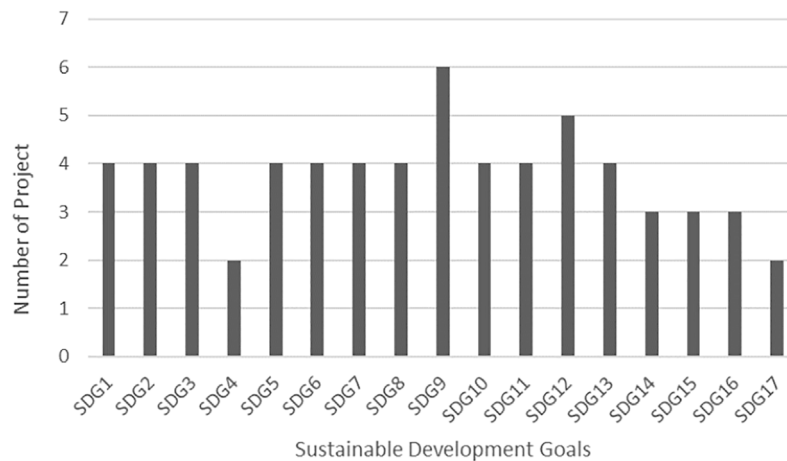
level. It was founded on four main elements: governance, collaboration, research and development, and transformative education (Corcoran et al., 2012). To promote sustainable development, RCE-Penang@USM has actively collaborated with local authorities and schools to build ESD strategy guides and enhance volunteerism within the sustainable development scope.

Since its inception, RCE-Penang@USM has supported the university in presenting a variety of sustainability-related activities to the community. In such regard, one of the most significant activities is a project called “Going Bananas” whereby a local community was equipped with the knowledge to reuse banana tree trunks for the production of paper and ornamental products, which has created an opportunity for youth and unemployed women to generate income. Another similar project is the “Wormi Compost” project, which trains the community to compost paddy-related with other biodegradable waste to produce fertilizers for organic farming. These projects have helped the community in reducing waste generation and consequently improving this community economic well-being and the surrounding environment.

### 3.3 Sustainability Courses

According to Ribeiro et al. (2021), students are one of the most influential stakeholder groups that will help a country promote sustainable development for the future society as they will be the next generation to inherit and lead the country in the future. According to Filho et al. (2021), universities need to play a role in implementing sustainability development more successfully by including sustainability into existing courses or building a new course specifically for the purpose. a specific course for the purpose (Filho et al., 2021). Hence, this public Malaysian university took the initiative to come up with an elective course, focusing solely on imparting the notion of sustainability to undergraduate students to equip them with sustainability knowledge and awareness. As illustrated in **Table 2** the course namely, Sustainability: Issues, Challenges and Prospects (WSU101) developed by CGSS and introduced to students during the academic year of 2011/2012 to assist the university in educating enrolled students from Arts and Sciences programmes on these issues and challenges of sustainability faced globally as well as to encourage them to share their ideas on how to address the challenges by using their knowledge in their respective backgrounds (Akib, 2017). The course does not merely focus on environmental aspects, but also considers and emphasises societal and economic issues that must be considered and addressed if one wishes to attain sustainability as the a long-term goal (CGSS, 2012).

This course encourages students to participate in the sustainability movement by completing sustainability projects at the end of the course. Students must create a small project that will assist society; particularly, the local community, address sustainability concerns and promoting them to other students to raise their sustainability awareness. All registered students must complete the small projects to demonstrate and prove their level of grasping of the sustainability concept at the end of the course.



**FIGURE 5** | Topic of research and projected conducted by undergraduate student for semester II academic year of 2020–2021.

This course also helps students to establish critical thinking skills regarding sustainability issues by exposing them to a variety of global sustainability issues and allowing them to explore and propose potential solutions to these issues with their peers (Akib, 2017). As part of each semester’s course requirements, undergraduate students will complete about 60 research topics and projects spanning all the aspects of SDG (Figure 5). Over the years, the enrolled students have completed more than 1,000 projects/research has been successfully completed by the enrolled students. In this course, some organizations that strongly advocated to sustainability matters have also been invited to share their experiences with the students. This education methodology is meant to help students in broadening their knowledge of the sustainability challenges outside their field.

Furthermore, the journey of developing sustainability in this public university was seen through implementing a sustainability-focused academic programme for prospective students. Such educational practice was observed in the Earth Institute at Columbia University, New York, United States when it introduced the Master in Sustainable Development Practice (MSDP) programme to prepare its students to develop and implement sustainable development approaches to solve pertaining issues and challenges related to sustainability. This academic programme, monitored by the Global Association Board of Master in Development Practice, will assist the university to develop a future generation that can understand and cross main boundaries (institutional, sectoral, and regional) to connect different stakeholders and methodologies and address convoluted development challenges in a sustainable manner. Students who enroll in the programme are can learn about different types of clusters, namely global health, science and engineering, management, and social sciences clusters. Another unique feature of MSDP is that the programme offers a course (Foundations of Sustainable Development Practice) that allows the students and global experts from different countries to connect and share their insights on sustainability-related matters via live video conference.

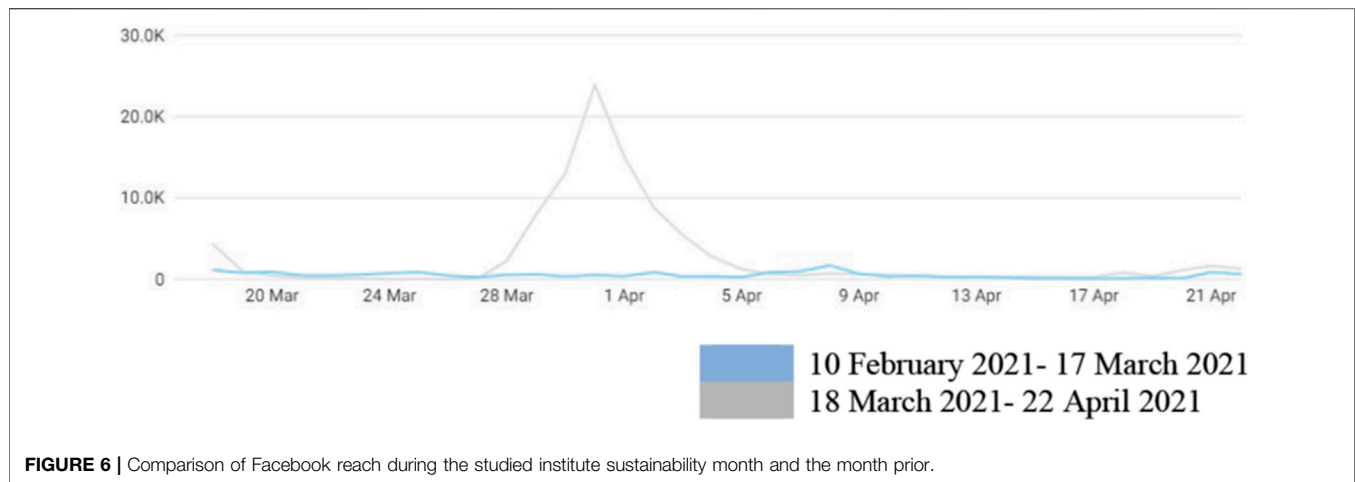
### 3.4 Sustainability Month

The studies institute as a case of sustainability development in higher education has proposed dedicating a special month led by CGSS, to actively promoting as many sustainability initiatives/activities as possible to raise sustainability awareness among the institute community and the public. Since 2021, April has been designated as the university’s sustainability month to commemorate Earth Day, which is celebrated annually and globally on April 22nd. All departments at the institute and the related public are encouraged to carry out sustainability programmes.

During its first inception, 35 sustainability programmes encompassing quizzes, webinars, campaigns, etc. which have brought together several local agencies and non-governmental organizations, were successfully organised and participated in by the society from inside and outside the institute and within the period of 18th March to 22nd April 2021. Figure 6 shows a significant rise in views during the sustainability month compared to the previous month. This demonstrates that sustainability month has considerably improved the university’s visibility as an entity committed to promoting sustainability both on and off-campus.

### 3.5 Sustainability Network

The UN has emphasized local and global partnerships in one of its SDGs, SDG17, “Partnership for the Goal”. To achieve sustainability, the goal stresses forming partnerships among relevant stakeholders. In an aim of stimulating sustainability integration in teaching, research, community engagement, and institutional arrangement, the case studied institute has established two major sustainability networks to bridge the gap between higher institutions with sustainability agencies, organizations, non-governmental organizations, and industries. Interestingly, such aim is within the scope of the Asia Pacific University-Community Engagement Network (APUCEN) which was established to bring together higher institutions and stakeholders, including those coming from the



Asia Pacific region, to cultivate and promote sustainability (Asia Pacific University-Community Engagement Network (APUCEN), 2021).

Furthermore, the South East Asia Sustainability Network (SEASN) focuses on connecting higher institutions and relevant stakeholders from Southeast Asia countries to address issues and develop solutions for the region's long-term sustainability. Since then, these well-known networks have brought together several higher institutions and organizations to exchange ideas and information to address sustainability-related matters within their respective regions. In addition, since their inceptions, several member countries have held a series of conference and community engagement activities such as Rebuild Nepal, Coaching4Fun Against Quakes, Multicultural Youth Service, International Conference on Sustainable Development Goals, and Thematic Working Group Lab, this aims to strengthen their partnership and improve the well-being of the community in the affected countries.

### 3.6 Waste Management

The studied institute community has built an environmental protection educational hub to maintain the sustainability mentality and practice. This is an initiative of various parties, including a non-governmental organization, industry, and the institute. Four projects have been laid out in the concept of education. Firstly, the organization of environmental education activities; secondly, the establishment of an Environmental Protection and Education Hub (EPEHub); thirdly reduction of carbon emissions; and fourthly, recycling resources. All projects were guided by the five R's: Rethink, Reduce, Reuse, Repurpose, and Recycle with a well-regarded non-governmental organization (NGO) with extensive experience in environmental protection and sustainable waste management, The Tzu Chi Foundation. In the studied university's trash management and sustainable waste practises, the 5Rs concepts are critical. It is not only referred to as resource recycling. Instead, recycling action serves as an entry point for practising the notion of 5Rs. Rethink, refuse, reduce, reuse, and repurpose are more effective in the sustainable waste management.

#### 3.6.1 Environmental Protection and Education Hub

The first R, rethink, is the most critical and practical idea in waste management and sustainable waste practices because it is within our control. For example, we can choose whether to bring our container or use a single-use plastic container to take away goods. Rethink can be fostered through education to heighten public understanding of environmental challenges. Since 2020, we have been focusing on educational activities and organising seminars. The first seminar was conducted in August 2020 at the Advanced Medical and Dental Institute (AMDI) and featured a presentation on the possibilities of recycling laboratory plastic. In April 2021, in connection with the institute's sustainability month, we held a second online webinar titled "Reduce single-use plastic on campus."

At the beginning of September 2021, we worked with Tzu Chi NGO to provide a series of online webinars to educate the institute's students and staff on sustainable waste practices, environmental protection, and sustainable lifestyles. Additionally, we developed a micro-credential course, "Waste reduction and recycling on campus," under the auspices of the Centre for Development of Academic Excellence (CDAE), so that the institute's students can enrol in the recycling course at any time, from any location, for free (Tan et al., 2021). As for March 2022, a total of 158 students have been registered with 41 of them completed and granted certificate. Internationally, 22 foreigner students were registered. Additionally, we are also preparing an exhibition or roadshow on environmental conservation and trash management on the campus. The educational series will assist the institute's students in developing sustainable behaviours.

Establishing the EPEHub on the institute's campus is critical in promoting diverse environmental protection activities. EPEHub will serve as the focal point for various of educational activities centred on various themes (e.g., recycle section, reproduce section, exhibition section, and low carbon footprints section). It is a space for students to learn about proper resource segregation, resource repurposing (e.g., producing eco-bricks and shopping bags from non-recyclable plastics), exhibiting repurposed items or recycled art, planting organic crops, and promoting plant-

based diets. The EPEHub is also a composting facility for food waste. The EPEHub's primary function is to serve as a hub for knowledge sharing and experience exchange. The EPEHub is open to the public, school students, students from other institutions, as well as governmental and non-governmental agencies.

### 3.6.2 Environmental Protection and Education Point

To encourage staff and students to inculcate recycling and develop sustainable habits, we have established a new concept of recycling corner (recycle and education) as an Environmental Protection and Education Point (EPEP) at suitable locations on the campus. Staff and students can segregate their recyclable materials and deposit them in the provided recycle bins (paper, plastic, cans/metal, and e-waste). Additionally, a small space near the recycling corner is designated for educational exhibition purposes. This space will be used to display educational messages about environmental protection. The purpose of the education corner purpose is to raise awareness among the institute's personnel and students about the importance of sustainable behaviours. The recycling corner in the foyer of the main library (high-student-traffic locations) is the first in the institute to incorporate the education spot concept. Additionally, the institute's Green Ambassadors (student and academic volunteers) will regularly monitor the recycling corner to ensure it remains clean and tidy. There are further plans to add additional recycle stations at other.

### 3.6.3 Management of Laboratory Plastic

Another significant resource recycling endeavour is laboratory plastic recycling. It was observed that researchers and postgraduate students in most laboratories utilise a large volume of single-use plastics in their daily experiments and discard them as biohazard waste. On the other hand, many of these single-use plastic wastes are non-hazardous, non-infectious, and non-chemical in nature. These wastes can be decontaminated and cleaned before recycling. As a result, the laboratory plastic recycling programme was launched in 2019.

Prior to the campaign, local recyclers were invited to one of the institute's laboratories (the AMDI cancer laboratory) to inspect and appraise the laboratory plastics' recyclable potential. The scientists also visited the plastic recycler factory to analyse and learn about the recycling procedures. After confirming that the plastics could be recycled, standard operating procedures for decontamination were devised, and a single-use laboratory plastic recycling campaign was proposed. By May 2021, we will have collected around 50 kg of laboratory plastics and had them collected by a recycling company, earning some revenue for the institute instead of paying waste management costs to dispose of biohazard material.

## 4 LIMITATION

The rising literature on universities' responsibilities in sustainable development reveals symbiotic relationship between these two, as institutions today function to deliver

creative solutions, demonstrating their commitment to sustainability in the process (Alam et al., 2020). However, this study is only investigating this concept in a public Malaysian university, thus; the different implemented sustainability strategies and their outcomes must be also observed in private Malaysian universities sector too.

Based on the journey of sustainability in this university, one of the main hurdles in sustaining the practice and the short retention of recycling practice among the university community ever since the first flagship program of white coffin in 2009. Environmental illiteracy was noted when the recycle bin were full of rubbish (unrecyclable items). This warrants the implementation of awareness campaign which the advocacy of sustainability practice was continued with a more concrete, social, and material terms.

## 5 IMPLICATION

Taking the perspective of social practice in integrating the sustainability practices or more precisely recycle, reuse and reduce, the team from Centre of Global of Sustainability Studies, Universiti Sains Malaysia expanded the vision via community participation, in this context, USM community to start off. On top of the idealization of white coffin and courses related to sustainability practices, environment education hub and the more recent effort of micro-credential course that available to the public were also initiated focusing on USM community's participation. Green ambassadors' recruitment (volunteers) was commenced in 2020 in the university, consisting not only the student but also postgraduate research, and academician with total participation of 68 individuals. Systematic management of the recycle item through the environmental education hub take into account of temporal and spatial dimensions of volunteering participation in sustainability practice. This structural plan caters the social practice theory from the aspect of new knowledge input, enriching life experiences, create awareness and motivate change (Kolb, 1984; Penuel, 2016). It is believed that through the EPEHub, the retention of participation will be more sustainable.

## 6 CONCLUSION

The public's first perceptions of recycling resources are always connected with dirty recycle bins and foul odours; recycling containers are always mixed with non-recyclable garbage due to the public's lack of education and awareness of effective recycling practices. Over the years, the currently studied university has advocated for sustainable practices through the many programmes described in detail in this article. As a result, a strong sustainability attitude and cultural approach must be cultivated on the investigated campus to become ingrained in the community's everyday routine. Accordingly, education will always take precedence in our attempts to instil a sense of environmental responsibility in the studied public Malaysian university's students and workers. There is still



considerable room for improvement, and sustainable efforts such as food waste separation for composting encourage student involvement in various sustainable activities. To promote and grow environmental preservation and achieve the ultimate goal of a green campus it requires a strong support from multiple stakeholders, including student organisations, cafeteria operators, staff, students, and senior management. Graduate students at the investigated Malaysian institute have not only the knowledge but also the values necessary to care for and enjoy nature, as well as the ability to safeguard the only current available habitable planet, Earth! These sustainability strategies at higher academia and their effective implementations are in line with the urgent recommendations of the UN Climate Change Conference in Glasgow, 2021, to limit methane emissions by 2030.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding authors.

## REFERENCES

- Agency—USA, E.P. (2018). *The Components of Environmental Education*. Washington, DC, USA: Environmental Protection Agency.
- Akib, N. A. M. (2017). *Increasing Student Participation and Engagement in Sustainability Projects in Universiti Sains Malaysia (USM) through Kampus Sejahtera and WSU101: Sustainability Course for Undergraduates*.
- Alam, G. M., Al-Amin, A. Q., Forhad, A. R., and Mubarak, M. S. (2020). Does the Private University Sector Exploit Sustainable Residential Life in the Name of Supporting the Fourth Industrial Revolution? *Technol. Forecast. Soc. Change* 159, 120200. doi:10.1016/j.techfore.2020.120200
- Alam, G. M., Roslan, S., Al-Amin, A. Q., and Leal Filho, W. (2021). Does GATS' Influence on Private University Sector's Growth Ensure ESD or Develop City 'Sustainability Crisis'-Policy Framework to Respond COP21. *Sustainability* 13 (8), 4520. doi:10.3390/su13084520
- Aleluia, J., and Ferrão, P. (2016). Characterization of Urban Waste Management Practices in Developing Asian Countries: A New Analytical Framework Based on Waste Characteristics and Urban Dimension. *Waste Manag.* 58, 415–429. doi:10.1016/j.wasman.2016.05.008
- Asia Pacific University-Community Engagement Network (APUCEN) (2021). Background of Asia-Pacific University-Community Engagement Network (APUCEN). Available at <https://apucen.usm.my/index.php/en/September> 2021.
- Babaei, A. A., Alavi, N., Goudarzi, G., Teymouri, P., Ahmadi, K., and Rafiee, M. (2015). Household Recycling Knowledge, Attitudes and Practices towards Solid Waste Management. *Resour. Conservation Recycl.* 102, 94–100. doi:10.1016/j.resconrec.2015.06.014
- Cgss, C. f. G. S. S. (2012). *Sustainability @ USM Fact Sheets*.
- Corcoran, P. B., Hezri, A. A., Hollingshead, B. P., Weakland, J. P., and Hamid, Z. A. (2012). *The Ethical Dimension of Sustainability in Higher Education: Applying the Principles of the Earth Charter in Malaysia & beyond*. Perpustakaan Negara Malaysia.
- Dawda Badgie, M. A. A. S., Abd Manaf, L., and Muda, A. B. (2012). Assessment of Municipal Solid Waste Composition in Malaysia: Management, Practice, and Challenges. *Pol. J. Environ. Stud.* 21 (3), 539–547.
- Desa, A., Kadir, N. B. y. A., and Yusooif, F. (2011). A Study on the Knowledge, Attitudes, Awareness Status and Behaviour Concerning Solid Waste Management. *Procedia - Soc. Behav. Sci.* 18, 643–648. doi:10.1016/j.sbspro.2011.05.095
- Desa, A., Kadir, N. B. y. A., and Yusooif, F. (2012). Waste Education and Awareness Strategy: Towards Solid Waste Management (SWM) Program at

## AUTHOR CONTRIBUTIONS

Conceptualization, SC, MH and MT; methodology, TN, S-YC, and SM; formal analysis, TN, S-YC, and RA; writing—original draft preparation, TN, S-YC, SM, and CY; writing—review and editing, TN, S-YC, RA and SC, supervision, TN, S-YC, MT, CY, and MH, funding acquisition, RA. All authors have read and agreed to the published version of the manuscript.

## FUNDING

Authors would like to acknowledge the funding received from the grant 304/PFARMASI/6501084/U161, Global Research Translation Award via Global Challenges Research Fund by the UK government in carrying out this work, as well as the Graduate Student Financia Assistance (GRA-ASSIST) of Universiti Sains Malaysia. Besides, RA is the recipient of Universiti Sains Malaysia USM Fellowship Award (PFD0009/20(R)) from the Institute of Postgraduate Studies (IPS), Universiti Sains Malaysia (USM), Malaysia.

- UKM. *Procedia - Soc. Behav. Sci.* 59, 47–50. doi:10.1016/j.sbspro.2012.09.244
- Edwin, G., and Muthu, N. (2021). in *Sustainability and Climate Action in the Higher Education System*. Editor W. L. F. A. L. B. Tristan McCowan (Germany: Global University Leaders Council Hamburg), 72.
- Filho, W. L., Amaro, N., Avila, L. V., Brandli, L., Damke, L. I., Vasconcelos, C. R. P., et al. (2021). Mapping Sustainability Initiatives in Higher Education Institutions in Latin America. *J. Clean. Prod.*, 315. doi:10.1016/j.jclepro.2021.128093
- Giusti, L. (2009). A Review of Waste Management Practices and Their Impact on Human Health. *Waste Manag.* 29 (8), 2227–2239. doi:10.1016/j.wasman.2009.03.028
- Group, T. W. B. (2018). *What a Waste 2.0 2018, International Bank for Reconstruction and Development/the World Bank*. Washington, DC, 272.
- Herzner, A., and Stucken, K. (2020). Reporting on Sustainable Development with Student Inclusion as a Teaching Method. *Int. J. Manag. Educ.*, 18. doi:10.1016/j.ijme.2019.100329
- Ifegbesan, A. (2010). Exploring Secondary School Students' Understanding and Practices of Waste Management in Ogun State, Nigeria. *Int. J. Environ. Sci. Educ.* 5 (2), 201–215.
- Janmaimool, P. (2017). Application of Protection Motivation Theory to Investigate Sustainable Waste Management Behaviors. *Sustainability* 9 (7), 1079. doi:10.3390/su9071079
- Kolb, D. A. (1984). *Experiential Learning: Experience as the Source of Learning and Development*. Englewood Cliffs, NJ: Prentice-Hall.
- Licy, C. (2013). Awareness, Attitude and Practice of School Students towards Household Waste Management. *J. Environ.* 2 (6), 147–150.
- Manca, F., Sivakumar, A., Daina, N., Axsen, J., and Polak, J. W. (2020). Modelling the Influence of Peers' Attitudes on Choice Behaviour: Theory and Empirical Application on Electric Vehicle Preferences. *Transp. Res. Part A Policy Pract.* 140, 278–298. doi:10.1016/j.tra.2020.08.016
- Meidiana, C., and Gamse, T. (2010). Development of Waste Management Practices in Indonesia. *Eur. J. Sci. Res.* 40 (2), 199–210.
- Moore, H. E., and Boldero, J. (2017). Designing Interventions that Last: A Classification of Environmental Behaviors in Relation to the Activities, Costs, and Effort Involved for Adoption and Maintenance. *Front. Psychol.* 8, 1874. doi:10.3389/fpsyg.2017.01874
- Nation, U. (2020). Waste Management in Asean Countries. Available at: <https://environment.asean.org/wp-content/uploads/2020/03/Summary-Report-Waste-Management-in-ASEAN-Countries-UNEP.pdf>.
- Nations, U. (2015). *Transforming Our World: The 2030 Agenda for Sustainable Development*. New York: United Nations, Department of Economic and Social Affairs.

- Negara, J. P. S. P., Bandar, K. K., and Tempatan, P. D. K. (2013). *Main Report: Survey on Solid Waste Composition, Characteristics & Existing Practice of Solid Waste Recycling in Malaysia*. The World Bank, 165.
- Ngoc, U. N., and Schnitzer, H. (2009). Sustainable Solutions for Solid Waste Management in Southeast Asian Countries. *Waste Manag.* 29 (6), 1982–1995. doi:10.1016/j.wasman.2008.08.031
- Nguyen, T., and Watanabe, T. (2020). Autonomous Motivation for the Successful Implementation of Waste Management Policy: An Examination Using an Adapted Institutional Analysis and Development Framework in Thua Thien Hue, Vietnam. *Sustainability* 12 (7), 2724. doi:10.3390/su12072724
- Niazi, N. K., Murtaza, B., Bibi, I., Shahid, M., White, J. C., Nawaz, M. F., et al. (2016). “Removal and Recovery of Metals by Biosorbents and Biochars Derived from Biowastes,” in *Environmental Materials and Waste*. Editors M. N. V. Prasad and K. Shih (Academic Press), 149–177. doi:10.1016/b978-0-12-803837-6.00007-x
- Nik Khusairi Ibrahim (2008). *The Star.USM Bans Use of ‘white Coffins’*
- Onyanta, A. (2016). Cities, Municipal Solid Waste Management, and Climate Change: Perspectives from the South. *Geogr. Compass* 10 (12), 499–513. doi:10.1111/gec3.12299
- Penuel, W. R. (2016). A Social Practice Theory of Learning and Becoming across Contexts and Time. *A Soc. Pract. theory Learn. Becom. across contexts time* 4 (4), 30–38.
- Periathamby, A. (2011). “Municipal Waste Management,” in *Chapter 8 - Municipal Waste Management*. Editors T. M. L. Waste and D. A. Vallero (Boston: Academic Press), 109–125. doi:10.1016/b978-0-12-381475-3.10008-7
- Puppim de Oliveira, J. A. (2019). Intergovernmental Relations for Environmental Governance: Cases of Solid Waste Management and Climate Change in Two Malaysian States. *J. Environ. Manag.* 233, 481–488. doi:10.1016/j.jenvman.2018.11.097
- Razak, D. A. (2010). White Coffin Comes Alive. Available at: <http://eprints.usm.my/32655/1/DZUL78.pdf>.
- Ribeiro, J. M. P. (2021). Green Campus Initiatives as Sustainable Development Dissemination at Higher Education Institutions: Students’ Perceptions. *J. Clean. Prod.*, 312. doi:10.1016/j.jclepro.2021.127671
- Rodić, L., and Wilson, D. C. (2017). Resolving Governance Issues to Achieve Priority Sustainable Development Goals Related to Solid Waste Management in Developing Countries. *Sustainability* 9 (3), 404.
- Sarkodie, S. A., and Owusu, P. A. (2021). Impact of COVID-19 Pandemic on Waste Management. *Environ. Dev. Sustain* 23 (5), 7951–7960. doi:10.1007/s10668-020-00956-y
- Singhirunnosorn, W., Donlakorn, K., and Kaewhanin, W. (2017). Household Recycling Behaviours and Attitudes toward Waste Bank Project: Maharakham Municipality. *JABs* 2 (5), 17–26. doi:10.21834/jabs.v2i5.215
- Tan, M. L., Ying, C. K., and Ng, T. F. (2021). Waste Reduction and Recycling in Campus. Available at: <https://learning4life.usm.my/courses/usm-is-a-green-campus/?cl=1> (Accessed 02 26, 2022).
- Tripathi, A., Tyagi, V. K., Vivekanand, V., Bose, P., and Suthar, S. (2020). Challenges, Opportunities and Progress in Solid Waste Management during COVID-19 Pandemic. *Case Stud. Chem. Environ. Eng.* 2, 100060. doi:10.1016/j.csee.2020.100060
- Unesco, L. A., Heiss, J., and Byun, W. (2018). *Issues and Trends in Education for Sustainable Development*. Paris: UNESCO.
- USM, S. (2008). The White Coffin. Available at: <http://thewhitecoffin.usm.my/about%20us.html> (Accessed February 26, 2022).
- Weitz, N. (2019). *SDGs and the Environment in the EU: A Systems View to Improve Coherence*. Stockholm Environment Institute.
- Wilson, D. C., Velis, C. A., and Rodic, L. (2013). “Integrated Sustainable Waste Management in Developing Countries,” in *Proceedings of the Institution of Civil Engineers-Waste and Resource Management* (ICE Publishing). doi:10.1680/warm.12.00005
- Zurbrugg, C., and Ahmed, R. (1999). Enhancing Community Motivation and Participation in Solid Waste Management. *Sandec News* 4, 2–6.

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher’s Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Chan, Ng, Hassan, Ying, Tan, Mohd Radzi, Abou Assi and Chan. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.