University of Natural Resources and Life Sciences, Vienna
Department of Water, Atmosphere and Environment
Institute of Waste Management and Circularity
Muthgasse 107/III, A-1190 Vienna
Austria

External Evaluation ERASMUS Project “Sustainable solid waste management and policies, SWAP” (call 2020)

EVALUATION REPORT: FINAL EVALUATION

Ao.Univ.Prof. Dipl.-Ing. Dr. Stefan Salhofer

Vienna, January 12th 2024

Table of content

1 Introduction

The ERASMUS project "*Sustainable solid waste management and policies, SWAP*" is implemented from Jan 2021 to January 2024 under the coordination of TU Hamburg. In autumn 2022, the Institute of Waste Management and Circularity, University of Natural Resources and Life Sciences Vienna was contacted and asked to serve as external evaluator for this project. After signing an agreement, on December 12, 2022 a quality workshop was held at the TU Hamburg, where all project partners were present. This report summarises the finding of the midterm evaluation, an external evaluation of the final results is planned for December 2023. The scope of the evaluation addresses the content and the management of the project and, no financial information was evaluated.

2 Project information

The following aims, activities and expected results are taken from the project proposal (following parts *in italics*).

2.1 Aims

Considered the common needs as well as the needs specific for each Partner Country within the Southeaster Asian region, the general aim of SWAP project is to contribute and support in building capacity at tertiary level and to support training addressed to the vulnerable group of informal waste practitioners.

In this sense, the project has the purpose of improving entrepreneurship as well as the employability of university graduates of the HEIs from Southeast Asia in the sector of sustainable solid waste management, thanks to a close cooperation among the actors of the quadruple-helix. Thanks to this holistic structure, SWAP Project will pave the way to support relevant policies, providing with high quality educational products and tools.

To pursue this general aim, the following specific objectives are to be achieved during the project´s lifetime:
1. Developing new training and teaching programmes addressing the issue of sustainable solid waste management and integrating technical education with training sessions addressing business start-up in the field of solid waste management.
2. Implementing measures and inclusion policies for the informal sector, namely involving this target group to safer and healthier work practices and introducing them to newly developed TVET products.
3. Setting up Training Hubs that can be used also beyond the project´s closure.
4. Establishing the TVET products focused on sustainable solid waste management within the activities of newly established "Training Hubs for Sustainable Solid Waste Management and Policies".
5. Institute sustainable synergies and links with the stakeholders in the private sector in order to fulfil their need in specialised personnel handling post-consumer material, training needs and enhancing the employability of university graduates.
6. Endorsing continuous cooperation, exchange of know-how and good practices between the Southeast Asian region between EU and Southeast Asian HEIs.

7. Disseminating project results and sustainability concepts in the field of solid waste management to the general public and the society at large, involving in the dissemination process also school students and their relatives.

2.2 Activities

In order to fulfil the aim and the specific objectives set for the SWAP project, the working methodology is structured on four major blocks of activities:

Block A: complete the preparatory activities performed during the proposal preparation, closing the frame on the current situation of the higher education institutions in the sector of waste management, in terms of what is their educational offer, what is their relation with relevant detected need, with the local industries operating in the sector.

Block B: increase entrepreneurship and employability of the graduates in the sector by increasing the quality of educational products that they currently receive and complementing them with the topics of sustainability and business creation. An active involvement of stakeholders from private sector in shaping the educational products according to their specific needs is also beneficial to this end.

Block C: provide the HEIs with new tools, governance models and educational strategies and policies and push for modernisation in the management of learning systems.

Block D: coordinate the overall project to ensure its successful running and that the activities and results meet the quality standards set at the beginning of the project. Ensure that the results are further exploited and raise awareness in young generation of students.

In order to properly developing this methodology, the project will start with the completion of preparatory activities, performed in the proposal preparation stage with the development of a need analysis at the level of Partner Country, and at the level of each Partner Country Institution. WP1 will allow gathering all the information of the proposal preparation phase as well as completing the information related to the expectations of the industries operating in the waste management sector towards the graduates. WP1 will last for 4 months, as this is the envisaged time to fulfil at best the foreseen activities. The major milestone (M1.1) is the report "Solid Waste Management in Southeast Asia: What does the industry expect?". Measurable indicators: number of courses matching the needs coming from the waste management private sector.

Information gathered for WP1 will serve as a basis for the development phase of the project. The development WPs are composed of tasks and for each task more sub-tasks are specified. The Consortium chose to set this approach already at proposal stage, so that the activities to be implemented are clear and defined.

WP2 and WP3 will run in parallel but their development will be similar. These two WPs aim at fulfilling the Block B identified above.
Specifically, WP2 deals with the development of educational products for academia. Workshops and study visits will contribute to this end as well as academic staff training sessions. After development of the educational products, it is foreseen that the latter will also be implemented and monitored during a pilot period. Further improvement and eventual

accreditation are also an important activity of this WP. The major milestones for WP2 are: (M2.1) delivery of the teaching material, (M2.2) seminar for academic staff training, (M2.3) successful pilot semester, (M2.4) successful accreditation process. Measurable indicators: number of education products developed for academia in the field of SWM; number of seminars for academic staff training; number of University courses successfully implemented and accredited.
WP3 deals with the development of TVET educational products. Workshops and study visits will contribute to this end as well as train-the-trainers sessions. After development of the educational products it is foreseen that the latter will be addressed to local trainers, so that they can implement these products. The developed products will also be adapted to meet the needs of target groups at different educational levels. The main beneficiaries of this activity will be representatives of the informal sector working with waste. All developed products will be monitored during a pilot period, further improved and eventually accredited. The major milestones for WP3 are: (M3.1) delivery of the training, (M3.2) train-the-trainers sessions, (M3.3, M3.4) successful pilot courses targeted to both trainees and informal sector representatives. Measurable indicators: number of training courses for TVET; number of trained trainers; number of pilot courses targeted to trainees and informal sector representatives.
WP4 will cover the activities in Block C. Educational strategies and tools will be developed. Specifically, within WP4:
- an open online platform will be implemented that will be used as learning management system, i.e., a sharing platform and a database for and of experts in the waste management sector;
- Training hubs will be implemented. First, all design requirement will be developed (quality standards, goals, tasks, governance schemes, business plans), and then the physical set-up of the hubs will take place;
- Multi-stakeholders governance teams representing all typologies of stakeholders involved will be established to monitor functioning and results of the Training Hubs.
Major milestones of WP4 are the (M4.1) successful implementation and running of OOLMS, (M4.2) Feasibility studies for the training hubs and (M4.3) multi-stakeholder governance teams.
Measurable indicators: number of hours of use of the open online platform; number of training hubs.

Three horizontal activities frame the project in its whole duration: Quality Plan related activities (WP5), dissemination and exploitation activities (WP6) and project´s management (WP7).
Activities foreseen in WP5 aim at ensuring the quality of the project´s implementation and results, based on quality standards and indicators that will be set in the quality control plan. Milestone in WP5 are the results from (M5.1) internal and (M5.2) external monitoring.
WP6 is crucial for the broad dissemination and exploitation of the project´s results, targeting actions to different stakeholders. An important approach foreseen in WP6 is the implementation of activities for raising awareness on young generation of students, highlighting the importance of sustainable SWM and offering them an overview on the educational opportunities (at academic and TVET level) they have if they are willing to continue with their studies. A Dissemination Plan will be then set at the start of the Project, so as to detail all dissemination activities, relevant timelines, measurable indicators.
WP7 deals with the overall project management and coordination.

2.3 Expected results

Partner Country: VIETNAM
- n.1 report on current education on solid waste management in Vietnam
- n.4 academic staff for each HEI involved in two study visits in EU universities
- n.2 new innovative courses developed (20-50 students benefit per semester)
- n.4 existing courses updated (150-170 students benefit per semester)
- Workshops on educational products in sustainable solid waste management (SSWM)
- Recommend reform policies in SSWM
- Open Online Learning Management System (OOLMS) and its handbook and the database of experts
- Multi-stakeholders governance teams
- High quality training courses
- Training Hubs dedicated to sustainability in waste management, that will encounter big interest in the students and in the companies in the sector. The Training Hubs would be used for future new training courses as well.

Partner Country: CAMBODIA
- n.1 report on current education on solid waste management in Cambodia
- n.4 academic staff for each HEI involved in two study visits in EU universities
- at least n.3 new high quality and officially accredited training and/or teaching courses on sustainability in waste management (20-40 students benefitting)
- training products and tools addressed to informal workers
- Market based curriculum and courses relating to waste management will be implemented in HEIs
- Establishment of Waste management units in the University departments
- Interest increase from the companies in the sector (increasing number of MoUs signed between HEI and industrial partners)
- The OOLMS and its handbook and the database of experts
- Recommend reform policies in solid waste management
- Multi-stakeholder governance teams
- Students and teachers utilize and share obtained knowledge and skill in the field of solid waste management with communities and relevant parties
- Vocational Training Hub on Waste Management Centre to be established.
- Course designer handbook.

Partner Country: THAILAND
- Interest increase from the companies in the sector (increasing number of MoUs signed between HEI and industrial partners)
- Building up of the Sustainable Solid Waste Management Training Hubs
- Training course on sustainable solid Waste Management for enterprise, community, and school to strengthen enterprises and community capacity by using provided knowledge and technical support services
- The industry or community has proper solid waste treatment policies and management to reduce carbon in environment
- Constructive relationship with relevant private and public sectors, e.g. private landfill owners, municipalities, etc.
- Role of involved HEIs as the leading institutes in sustainable solid waste management in the country and in the whole Southeast Asian region.

In general, the following non tangible results are also expected to be achieved in all the Partner Countries involved in the SWAP Project:
- Growth in the academic level of University staff and relevant quality of the courses offered by the Country Universities;
- Growth in knowledge, competence and skills of university students/new graduates;
- Improvement in the entrepreneurship and employability of graduates;
- Growth in knowledge, competence and skills of Vocational and Educational Trainers, VET trainees, informal workers;
- Growth in the capacity of the waste practitioners and companies to address the technical, environmental and socio-economic issues connected to solid waste management and valorization;
- Increase in the capacity of the industrial system to exploit the competitive advantage connected to the sound management and valorization of solid waste;
- Awareness-raising by the whole socio-economic system, including National/local Governance/Public Authorities, profit/no-profit associations, civil society at large.

3 External evaluation procedure

The external evaluation was undertaken in the fields of project implementation, efficiency of the consortium, strengths, weaknesses, opportunities and threats (SWOTS analysis) and future challenges.

Evaluation methods

- Review of project outputs (deliverables, teaching materials, dissemination materials, other)
- Quality workshop with a general discussion, and interviews with representatives of the Asian partner Universities. The quality workshop took place on Dec 15th 2023 morning and Dec 18th 2023, morning and included the quality management board (see Tab. 1 for details).

In details, the following steps were taken:

Project achievements were analysed through interviews and questionnaire.
In the interviews, the attention of the project within the individual University, extended contacts to stakeholders, international visibility and main benefits were asked. The list of deliverables was compared to the project application. For the teaching activities, the training hubs and related activities at the hubs, the academic project partners provided information through the questionnaire.

The **consortium efficiency** was investigated in the interviews.
Here the positive aspects of the collaboration, negative impressions and proposals, how to overcome those negative experiences were asked.

The input for the **SWOT analysis** was gained through interviews and the compiled to more general statements. For strengths and weaknesses (as internal factors), the location of partners, human resources and other aspects were asked. For opportunities and threats (as

external factors) the stakeholder relations, funding opportunities and other aspects were asked. The SWOT analysis was undertaken both for the project consortium and the project implementation.

Strategies for the future were addressed in the questionnaire, where the questions were sub-divided into waste streams, technology and processes and management aspects.

Tab. 1: Quality management board

partner	*representative*	*email*
TUHH	Kerstin Kuchta (Chair)	kuchta@tuhh.de
TUHH	Madgalena Kitzberger	magdalena.kitzberger@tuhh.de
IFOA	Luca Boetti	boetti@ifoa.it
POLIBA	Sabino De Gisi	sabino.degisi@poliba.it
EURO	Christina Stamataki	chstamataki@eurotraining.gr
HUAF	Le Thi Thuy Hang	lethithuyhang@huaf.edu.vn
TUAF	Truong Thi Anh Tuyet	truongthianhtuyet@tuaf.edu.vn
RUA	Kim Soben	kimsoben@gmail.com
UHST	Pin Tara	pintara30@gmail.com
COMPOSTED	Rithy Uch	rithy@comped-cam.org
CMU	Patiroop Pholchan	patiroop@eng.cmu.ac.th
MJU	Mujalin Pholchan	m.k.pholchan@gmail.com

4 Final evaluation - results

4.1 Project achievements

The project team gained **attention within University** at the institute level, social media played an important role. At TUHH, project activities were combined with Girls Day (MINTS). Further colleagues from the University acted as guest lecturers and brought additional input.
Attention within university through new courses introduced and info days
Internal visibility: a recycling center was opened - good combination; good PR; useful teaching materials

In terms of **extended contacts**, stakeholders in the partner countries were named
Further options came with the Erasmus+ cluster meeting; many contributions in local media (TV, newspapers, videos on social media).
Intensified contact with ministry enabled another project on biochar (HUAF); another project on fertilisers was initiated
The network with partners established in the project will continue in the future
Publications are planned
New industry contacts (plastic waste, composting) were established
New contacts: cooperation with ministry, NGO and other stakeholders (private sector)
promotion for Zero Waste

International visibility was gained
Through better contact with Universities from Asia and Europe
attendance at conference, MoU between Asian partners, articles to be published, cluster meeting in Bangkok
through partners in Vietnam and Cambodia
through participation at international conferences and workshop the project was disseminated.

Main benefits are extended know-how, and new lectures implemented
Waste management as a topic gained attention
Public awareness was raised;
Trainings (specifically in the farming sector) are in demand
Important outcome is new courses (Bacc and Master programme)
new equipment and training hubs
Another benefit is additional equipment;
new courses in waste management implemented; update of existing courses; learning culture

Tab 2: Deliverables and status of achievement

No	*deliverable*	*due date*	*status*
D1.1	Education on Solid Waste Management. The cases of Vietnam, Cambodia and Thailan	Apr 21	completed
D1.2	Solid Waste Management in Southeast Asia: What does the industry expect?	Apr 21	completed
MAR1		May 21	completed
D2.1	Modules to be developed for academia	Aug 21	completed
D2.2	Teaching material on Sustainable Solid Waste Management for academia	Mar 22	completed
D2.3	Improvement of the developed academic educational products	Dez 22	completed
MAR2		Jan 24	completed
D3.1	Courses to be developed for TVET	Aug 21	completed
D3.2	Training material on Sustainable Solid Waste Management for TVET	Mar 22	completed
D3.3	Educational products for informal workers	Okt 22	completed
D3.4	Improvement of the developed training products	Dez 22	completed
MAR3		Jan 24	completed
D4.1	Open On-line Learning Management System	Nov 21	completed
D4.2	User handbook	Feb 22	completed
D4.3	Course designer handbook	Apr 22	completed
D4.4	Training Hubs Feasibility studies	Aug 22	completed
D4.5	Guidelines for management of multi-stakeholder governance teams	Feb 23	completed
D4.6	Report on implementation and functioning of training hubs	Dez 23	completed
MAR4		Jan 24	completed
D5.1	Definition, sharing and implementation of the quality plan	Mar 21	completed
D5.2	Risk management and mitigation	Apr 21	completed
D5.3	Quality Assurance Committee Meetings	Mai 23	completed
D5.4	External evaluator report	Dez 23	
MAR5		Jan 24	completed
D6.1	Dissemination plan	Apr 21	completed
D6.2	SWAP website	Dez 23	completed
D6.3	SWAP dissemination portfolio	Dez 23	completed
D6.4	Sustainability and exploitation plan	Sep 23	completed
MAR6		Jan 24	completed
D7.1	Partnership Agreement	Mar 21	completed
D7.2	Management Manual	Jun 23	completed
D7.3	Financial management handbook	Apr 21	completed
D7.4	Financial management seminars and consultation (event – minutes)	Mar 21	completed
D7.5	Internal Communication Plan	Apr 21	completed
D7.6	Final financial and content reports to the EACEA	Dez 23	
MAR7		Jan 24	completed

Remark: D5.4 is the present report; D7.6 is to be submitted to EACEA at the end of the project period.

Teaching

Table 3 lists the academic courses developed and implemented in the project. Beside the course title, the level (Bachelor / Master), the ECTS, year of the first implementation and their status in the curriculum is shown.

Tab 3: Academic courses developed and implemented in the project

	course title	level	ECTS	first implementation	status
HUAF	Solid waste management	Bacc	2	2023	
HUAF	Environmental management of urban and industrial zone	Bacc	2	2023	
HUAF	Environmental and sutainable development	Master	2	2023	
TUAF	Waste resources management	Master	2	2023	elective
TUAF	Solid waste management and treatment	Bacc	3	2023	elective
TUAF	Environmental microbiology	Bacc	3	2023	elective
RUA	Sustainable Solid Waste Management and Circular Economy	Master	3	2023	mandatory
RUA	Compost Production for Sustainable Agriculture	n.a.	n.a.	2023	
UHST	Introduction to Sustainable Solid Waste Management and Circular Economy	Bacc	3	2023	
MJU	Environmental technology for sustainable development	Master	3	2022	mandatory
MJU	Environmental pollution treatment technologies	Master	3	2022	mandatory
MJU	Environmental quality sampling and analysis	Master	3	2022	mandatory
MJU	Integrated municipal solid waste management	Master	3	2022	elective
MJU	Sustainable solid waste management	Master	3	2022	elective
MJU	Hazardous waste disposal and management	Master	3	2022	elective
MJU	Waste management technology aspects in a circular economy	Master	3	2022	elective
MJU	Waste treatment and utilization	Bacc	n.a.	2024	mandatory
MJU	Waste minimization and clean technology	Bacc	n.a.	2024	elective
MJU	Solid waste management aspects in circular ecology	Bacc	n.a.	2024	elective
MJU	Waste treatment and utilization	Bacc	n.a.	2022	mandatory
MJU	Pollution prevention	Bacc	n.a.	2022	elective
CMU	Solid Waste Management	Bacc	3	2022	
CMU	Fundamental of Material Flow Analysis and Life Cycle Assessment	Bacc	3	2022	
CMU	Circular Economy and Sustainable Resource and Waste Management	Master	3	2022	

Training Hubs

As a part of EU co-funded Erasmus+ program Capacity Building in Higher Education project SWAP, a training hub “Solid Waste Management” has been established and operated at HUAF. The lab of SWAP training hub is located at the Department of Crop Science (30 m2). Another larger room is assigned to the SWAP Training Hub for seminars, workshops or meetings (60 m2). Besides, the experimental site is implemented at Centre for Agricultural Research and Services (18.000 m2), about 15 km from the main campus. In terms of equipment, we could exploit the available equipment from the **U**niversity and the equipment funded by the SWAP project of Erasmus+ program. Presently, the SWAP training hub has been operated with the financial support from University and SWAP project. After ending the SWAP project, its earnings for the projection for the next 3 to 5 years will come from fees from training activities; consultant and technology transfer services or research projects.

TUAF established the *Solid Waste Management Training Hub* with the support of Sustainable Solid Waste Management and Policy project (SWAP) in early 2023. As part of this endeavour, we have inaugurated the training hub at Thai Nguyen University, managed by the Faculty of Environment. This hub features an administrative office and a laboratory for experiments and training on the second floor of the Faculty of Environment building. The **t**raining **h**ub is equipped with equipment including research tools, computers, and specialized tools for agriculture and forestry studies such as

- Solid waste crushers
- Biochar/AC production equipment (Incinerator)
- Drone for waste volume estimation
- An administrative room, a training room, computer and projector

The Training Hub operates under the guidance of the University Director Board and is managed by the Faculty of Environment. The faculty's lecturers and staff play a pivotal role in facilitating the training hub's activities. They actively contribute through short training sessions, public awareness programs, and seek collaborative opportunities with industry stakeholders. These dedicated efforts from the faculty members significantly support and enhance the operations and initiatives of the training hub.

The training hub at **RUA** is located in the Center for Agricultural and Environmental Studies, which has sufficient space and equipment for the learning process and practices, Physical space: CAES-RUA set up a room to organise seminars or training courses in theory for about 100m2 and a larger composting house for practice is about 140m2.

At the **UHST** Campus, the training hub was established under the management of the Faculty of Agriculture. The office space of the training hub is (4 m*5 m), and the composting house size was (11m *22m). The UHST training hub resources, including training rooms, laboratory, computer, projector and IT system is located at laboratory of Faculty of Agriculture of the University. All lab equipment and tools including the existing one and equipment from SWAP budgets will be used during the training. The training hub was established to support the University by providing capacity building on solid waste management, including waste management technologies, building research partnership among relevant stakeholders, including students, farmers, agricultural cooperatives, agricultural communities, NGOs, entrepreneurs, relevant stakeholders and development partners. The equipment of the SWAP training hub provided by SWAP project funds under the Erasmus+ program. The equipment of the training hub are follows: high-end laptop, LCD projector, smart TV, compost house, double shaft shredder, extruder, wheel loader,

screening machine, and other hand tools including sorting table, whiteboard, a set of wrenches, volt meter, personal protective equipment, cordless screwdriver, and a set of screwdrivers.

The principal objective of the **MJU** training hub is to address environmental concerns related to the management of agricultural waste, with a concurrent emphasis on promoting sustainability for the community. The course content is designed to enhance and fortify the capabilities and competencies of local communities, farmers, small and medium-sized enterprises, local authorities, and University alumni in the creation of value-added products from agricultural waste. The income from products will incentivize communities to stop open burning of agricultural waste and drive circular economy in the agricultural sector.

CMU's training hub is located at the Department of Environmental Engineering, Chiang Mai University, Thailand. The lecture room is on the third floor and equipped with projectors, screens and the sound system purchased using the equipment budget of SWAP. This lecture room can support up to 60 trainees. For the practice or hands-on training, currently, all equipment (i.e., plastic shredder, filament extrusions and 3D printing) are installed in the workshop hall of the Department. All equipment is suitable for 5-10 groups of trainees (each with about 1-3 members) per day. The Department has just been granted with the budget from the government to build the practice room for the training hub on the top floor. This room will enable the Department to arrange the activities more properly with all required safety measures implemented. The completion of this newly built room is expected to be at the end of the year 2024.

Tab 4: Courses at the training hubs

	training / event	type	target group	year
HUAF	Agricultural waste ulitization into organic fertilizer for crop production	TVET	government, private sector	2023
HUAF	Information day	event	students, pupils	2022
HUAF	Painting day for future environment	event	pupils, teachers	2022
HUAF	Waste recycling contest towards Green Campus	event	students, pupils	2023
TUAF	Training on waste sorting and segregation	TVET	farmers	2023
TUAF	Training on composting and organic waste	TVET	farmers	2023
TUAF	Training on biochar application	TVET	farmers, students	2023
RUA	National dissemination workshop on sustainable solid waste management	TVET	government, private sector	2021
RUA	Dissemination seminar on municipal solid waste management	TVET		2022
RUA	Compost production for sustainable agriculture	TVET		2023
RUA	Capacity building on solid waste management and recycling	TVET	start-ups	2023
RUA	Inauguration day	event		2023
UHST	Solid Waste Management at in University of Heng Sarin Thbongkhmum	TVET		2023
UHST	The inauguration of the Training Hub for Sustainable Solid Waste Management	event		2023
UHST	Solid Waste Management at in University of Heng Sarin Thbongkhmum	TVET	students	2023
UHST	SWAP info day	event		2023
MJU	Agricultural waste ulitization and organic waste treatment	TVET	farmers, other	2023
MJU	Agricultural waste ulitization and organic waste treatment	TVET	farmers	2023
CMU	Plastic waste segregation and circular-based utilization	TVET	schools, municipalities	2023
CMU	Biogas technology: principle, design and operation	TVET	universities, factories	2023

4.2 Consortium efficiency

What worked well?
partners were active and interested in the project
regular meetings, communication
in person meetings (after COVID period), important for coordination;
telegram group worked easier than emails;
informal cooperation well developed, friendly atmosphere
networking, knowledge transfer, strong support by partners
good communication with COMPOSTED
good cooperation with European partners; good (informal) communication with Asian partners
quality management ensured good quality

What can be improved?
slow response from some partners
language barriers
online learning platform not much used
delays in delivering results
more training needed
excessive documentation and reporting required
at the begin of the project lacks due to COVID, when no travel was possible

What can help to make co-operation easier?
more meetings with WP leaders,
face to face meetings are important for mutual understanding
face to face meeting better than online (was not possible in the first year); not enough time for board meetings
personal contact (formal and informal)
fast communication
regular meetings
use of social media (like telegram, whatsapp)
community, NGO and private sector involvement
better support from EACEA;
more travel days to understand the partner countries better

4.3 SWOT Analysis

SWOT Analysis – project consortium

Strengths	**Weaknesses**
<u>Location of partners – long distance</u> - online meetings very helpful - social media bridge distance - good communication <u>Human resources</u> - different background of partners (but also a limitation, eg. agricultural university with no expertise in plastic waste) - non-academic partners with other training approaches - fast reaction of partners - mutual support - composting know-how; - good lead of the project <u>Other</u> - good cooperation - know-how of European partners in waste management, good training - many partners and countries involved; - good framework with defined tasks for every partner	<u>Location of partners – long distance</u> - distance - travelling is time consuming and expensive <u>Human resources</u> - different context, background - different levels of experience - more involvement of the European University professors <u>Other</u> - time zones - readiness of partners and motivation
Opportunities	**Threats**
<u>Relationships with stakeholders</u> - close cooperation - sharing research experience, joint seminar planned - more exchange of information - contact with groups of farmers, and groups of alumni; - MoU with mobile network provider (future e-waste collection) <u>Funding (other sources outside the project)</u> - waste management today is a national priority, good opportunity for projects - for future projects (research project developed and applied) - in preparation to apply for further funding - proposal in preparation - a new project with Swiss partners developed - funding for awareness raising (with kids) <u>Other</u>	<u>Relationships with stakeholders</u> <u>Funding (other sources outside the project)</u> - challenging <u>Other</u> - an award could not be given due to funding rules

SWOT Analysis – project implementation

Strengths	**Weaknesses**
Finances available - today funding available (hot topic), fees from student help to maintain training hubs; consultancy service and technology transfer - budget sufficient Current processes (is the procedure in the project compatible with internal processes at Universities?) - smooth progress; meetings with university leaders helped most - no conflicts, rector is an important supporter of projects Other - many additional activities of students with composting - good support from University	Finances available - rising prices - time consuming project management - funding for awareness raising could be extended Current processes (is the procedure in the project compatible with internal processes at Universities?) - much reporting (time consuming) - administration complicated - TVET was not usual at CMU, was adjusted Other
Opportunities	**Threats**
Market trends (teaching methods, …) - different situation at Asian Universities; gamification very welcome - increasing interest in waste management - COVID was the time to establish distant learning; the project supported this strongly - European approach to combine lecture and hands-on is very helpful Funding (other sources outside the project) - increased opportunities for fund raising - to combine theory and practice - additional equipment from the project - new funding; also future cooperation Demographics (number of students) - enough students - increasing number of students - involvement of students to activities of the university in plastic waste - good job opportunities for students new regulations addressing waste management - support by the government - composting as a business opportunity - teaching with up-to date content - climate and carbon neutrality has become very important - universities need to offer new learning Other - environmental laws, waste classification, fee	Market trends (teaching methods, …) Funding (other sources outside the project) Demographics (number of students) - decreasing number of students in environmental studies new regulations addressing waste management Other - how to raise public awareness for waste management

4.4 Strategies for the future

Waste streams:

At TUHH, there is considerable potential for advancing teaching and training activities in waste management. We see the need to enhance knowledge and collaboration in international waste composition and streams. Understanding global waste composition equips students to develop solutions applicable on an international scale. While all streams are essential, emphasis should be placed on organic waste management due to its significant contribution to overall waste volumes. Additionally, specialized courses on plastic waste management, C&D waste, e-waste, and hazardous waste are critical to address this persistent environmental challenge.
In terms of waste streams, there is significant potential to develop specialized training modules that focus on the identification, categorization, and management of different types of waste. This can include: sustainable practices in waste handling, sector-specific waste management, and innovative waste processing techniques.

In Thailand, the composition of waste is changing; still organic waste has the largest share, but plastic waste and e-waste are growing. Collection is a challenge, separate collection and incentives are needed. An unsolved topic is construction and demolition waste; a major challenge poses the informal recycling sector.
MJU has developed a road map toward eco-university and zero carbon emissions university. The training hub and awareness raising for a young generation and communities surrounding are vital for our teaching, academic service, and research duties. Further knowledge, technological practice and application and the management of waste streams like e-waste, demolition waste, plastic and bioplastic waste and agricultural waste are required to drive the green policy and implementation.
As for the teaching activities, changes of waste compositions, e.g., increase of plastic and electronic waste (e-waste) components, will alter the way of solid waste management in Thailand. Contents of the teaching materials and class activities need to be adapted in order to support this trend. To be in line with circular economy, which has been promoted as the way to develop the country, suitable methods for upcycling waste components also need to be included. As some inappropriate practices used to be implemented in the country, especially for E-waste dissembling and recycling, these activities have been banned. Knowledge and good practice on these issues should be included in the curriculum for the university students or as courses for interested participants (at the training hub) so that the activity can be promoted as a way to gain revenue without causing environmental damages. Even though changes in waste stream and composition are expected to occur, as an agricultural country, organic waste would still be the main component in Thailand's solid waste stream. Dissemination of suitable methods to transform this waste stream into usable products, such as compost and biogas needs still to be done. To have the effective solution, not only the technological aspect but also economic, logistic and business skills are needed. Some other higher-value products, e.g., ethanol and butanol, also have potential as the techniques can be applied also on the agricultural residues, which are significant portions of waste streams from some parts of the country.

In Cambodia, organic waste is the biggest challenge, composting is seen as solution.
Waste streams can differ in their composition, quantity and quality depending on the source and management system. The topic of waste streams and processes in Cambodia covers the generation, collection, transport, treatment, disposal and recycling of different types of waste, such as municipal solid waste, sewage and gaseous emissions.

For Vietnam, organic waste and plastic waste are seen as most challenging.
Developing specialized teaching materials for different types of waste; Integrating hands-on waste stream treatment education projects at university into real-world case studies from industry sectors.
Embracing a broader spectrum of waste streams beyond traditional solid waste management is pivotal. Incorporating specialized courses or modules focusing on electronic waste (e-waste), hazardous waste, and medical waste management could address the evolving complexities of modern waste composition. Designing programs that encompass identification, classification, collection, treatment, and disposal techniques specific for these waste streams will equip students with comprehensive knowledge and skills.

Processes and technologies:

A deeper grasp of local technology, including process engineering, is crucial for bridging the gap between theory and practical implementation in global waste management systems, as well as composting and recycling technologies.
Regarding processes, we can enhance our curriculum by integrating Waste Audit and Management Plans, Regulatory Compliance and Policy Understanding, Circular Economy and Waste Minimization.

In Thailand, many treatment facilities have been built, among other large landfills with landfill gas collection and electricity generation. Reliable trucks for waste collection are a need. Treatment of agricultural waste is unsolved.
In waste management, it's crucial to consider not only technology but also community participation. Raising self-awareness and encouraging participation in waste reduction, reuse, and recycling among staff, students, school students, and the wider community are further priorities.
Technologies developed in the EU, especially the equipment for solid waste management is also important. On this aspect, collaboration and capacity building with the European partners are essential. These technologies will greatly help to increase the efficiency of activities, e.g., waste segregation, collection and treatment, and also the safety for workers.

In Cambodia, today landfilling of waste is predominant, strong need for recycling and upcycling.

For Vietnam, the treatment of biomass is important, new technologies like to produce biochar are needed.
Organizing workshops on emerging technologies in terms of advanced recycling methods, smart waste management systems; Incorporating industrial field visits in lectures to offer practical understanding in waste treatment facilities for students.
To keep pace with advancements, exploring cutting-edge waste management processes and technologies is crucial. This involves delving into innovative methods such as waste-to-energy conversion, smart waste collection systems, advanced recycling technologies, and sustainable waste treatment approaches like composting and anaerobic digestion.

Integrating these contemporary techniques into the curriculum ensures students are exposed to state-of-the-art methodologies in waste management.

Other aspects (management):

Also addressing pressing environmental concerns, integrating Climate Protection and Circular Economy principles into the curriculum is vital. This prepares students to engage with sustainable practices and contribute to environmentally responsible waste management for TUHH as well as Asian Partners. Moreover, a key focus should be on consumer behaviour and waste reduction. Courses exploring the psychology of consumer choices and their impact on waste generation will equip students to drive positive behavioural change in society and raise awareness.
The incorporation of challenge-based learning and the development of a roadmap for innovative didactical approaches are essential. These approaches, including practical courses, provide students with hands-on experiences, deepening their understanding and preparing them for real-world waste management challenges.
Additionally, we can explore: collaborative projects and workshops, online learning modules, specialized training for different groups of stakeholders.

In Thailand, more education for management is needed, further the involvement of the wider society; the young generation is important and should be more involved.
Another point is the training on occupational health and safety for graduates, staff and informal workers who works for small waste pickers, private companies and waste management companies. At the moment we have only the regulations for industrial workers or special groups but not waste management workers.

In Cambodia, schools have an important role and should be included more.

In Vietnam, waste management in rural areas needs specific attention. Moreover, we can raise awareness for children and low-educational people in rural areas through community activities. Parallelly, training university students with personal skills helps us to convey a message in waste management for the community and their families towards environmental protection.
Infusing interdisciplinary elements into waste management education can significantly enhance students' perspectives. Incorporating subjects like environmental law and policy, economics of waste, and social dimensions of sustainability allows for a holistic understanding of waste management challenges. Encouraging collaborations between environmental scientists, engineers, policy experts, and social scientists can foster comprehensive solutions.
Offering opportunities for students to engage in real-world projects, internships, and fieldwork within communities or waste management industries can be highly beneficial. This practical exposure provides hands-on experience, encouraging problem-solving skills and critical thinking. Encouraging partnerships and collaborations with local authorities, industries, and waste management enterprises will provide valuable learning experiences for students.
Encouraging research initiatives in waste management innovation can yield breakthroughs. Supporting student-driven projects and research studies focused on waste reduction, resource recovery, circular economy models, and sustainable waste management practices can foster a culture of innovation within the university.

4.5 Summary

The external project evaluation was undertaken on the basis of a review of project outputs (deliverables, teaching materials, dissemination materials, other) and a quality workshop with a general discussion with the members of the Quality Management Board, on Dec 15th and 18th 2023.

- The **project achievements** demonstrate, that all project targets were reached, as visible from the list of deliverables. A comprehensive set of academic courses (newly developed and updated) are a major outcome of the project. The training hubs have been installed and a list of activities underpins a successful planning and implementation of the hubs.

- In terms of **consortium efficiency**, the project partners in the discussion pointed out the good cooperation and the mutual support in the consortium. The excessive requirements for documentation and reporting were also mentioned. In terms of options for improvement both online contacts as well as in-person meetings were named.

- The **SWOT analysis** of the project consortium highlighted the intensive cooperation despite long geographical distance between the partners. Different backgrounds of the partner institutions were names both as a strength and a challenge. The partners see many opportunities for further research through new stakeholder contacts and new project proposals.
- The SWOT analysis of the project implementation mentions rising prices with a fixed budget as a weakness, further time-consuming reporting and documentation obligations. As a strength, increasing opportunities for new research projects were named, good job opportunities for graduates and business opportunities.

- In terms of **strategies for the future**, a number of waste streams were mentions, like organic waste, e-waste, hazardous waste or C&D waste. For processes and technologies, the way forward from landfilling of waste to recycling is seen as the most important step. In terms of management aspects, the integration to the concept of Circular Economy is requested. Rural areas where infrastructure is less developed play an important role and should be addressed more in the future.