

Sustainability Report 2022



Vietnamese - German University



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List of abbreviations

| | |
|--------|--|
| AAU | Architecture and Design, Assumption University |
| ACCB | Actions for Climate Change and Biodiversity |
| GPE | Global Production Engineering and Management |
| HCMUT | Ho Chi Minh University of Technology |
| HCMUTE | Ho Chi Minh City University of Technology and Education |
| HEIs | Higher Education Institutions |
| LIC | Library - Information Center |
| RWHS | Rainwater Harvesting System |
| SDG | Sustainable Development Goals |
| SQM | Strategy and Quality Management |
| SUD | Sustainable Urban Development |
| TCKT | Architecture Magazine of Vietnam Associate of Architects |
| TDMU | Thu Dau Mot University |
| TDTU | Ton Duc Thang University |
| TLU | Thuy Loi University |
| UAH | Ho Chi Minh City University of Architecture |
| UN | United Nations |
| VGU | Vietnamese-German University |
| VLU | Van Lang University |
| VMD | Vietnamese Mekong Delta |
| WASH | Water, Sanitation and Hygiene |
| WTE | Water Technology, Reuse and Management |

Welcome at the Vietnamese-German University!

We are a public Vietnamese university developed in close partnership with Germany, which is based on the principles of academic freedom, unity of teaching and research and institutional autonomy. We are committed to excellence in research and teaching in the fields of smart engineering, information technology as well as business and economics relevant for both local and global sustainable development.

Our graduates are trained to combine rigorous theoretical knowledge with critical thinking skills to creatively solve problems and are ultimately well prepared to assume leadership in the next generation of scientists, engineers and managers. As an acknowledged research university with a distinctive profile, we are a driver for the economic, social and environmental development of Vietnam.

In our first Sustainability Report, we show what we have done at the VGU to implement the Sustainable Development Goals (SDGs) adopted by the United Nations in 2015. After giving you some key facts of the university at hand and outlining its focused SDGs, we present our engagement, teaching and research activities as well as projects that target the SDGs. Albeit the report aims at the year 2022, projects and activities might have been established earlier or may still be on-going.

1. The VGU at a glance



Figure 1: Signed declaration of intention for the establishment of VGU on 21/05/2007

1.1 Profile

The VGU was the first public university in Vietnam to be established in 2008 pursuant to intergovernmental agreements. The university has been developed following the model of German technical universities and has customised its training and research methods to suit Vietnam's conditions. The VGU interrelates the Vietnamese framework of higher education with German academic models and standards, whereby the degree programmes are being organised and conducted in close collaboration with German partner universities.

VGU's unique profile is based on a bi-national partnership between policymakers, managers and academics of a newly emerging country and of an economically advanced country. Between 2008 and 2022, 14 German higher education institutions have implemented a total of 16 study programmes (7 Bachelor and 9 Master programmes) at the VGU. End of 2022, the VGU had 2,335 enrolled students (82 international students, accounting for 3.5%); 1,441 students had at that time graduated with a degree awarded by a German university, supplemented by a VGU degree. The programmes are under the management of either the Faculty of Engineering or the Faculty of Economics and Management.

1.2 New campus



Figure 2: VGU Inauguration ceremony of new campus 2022

The foundation for VGU's further development was set in 2022, when the university could finally settle down on its own campus. On 11/11/2022, the VGU inaugurated its brand-new facilities, located in Ben Cat of the Southern province Binh Duong (40 km North of Ho Chi Minh City). Besides auditorium, library, lecture halls, technical labs and offices for academics and administrative staff, the new campus is equipped with a sports centre, students' dormitories, a canteen, an exhibition building and a lecturer village. Technical details of the campus' premises and facilities are as follows:

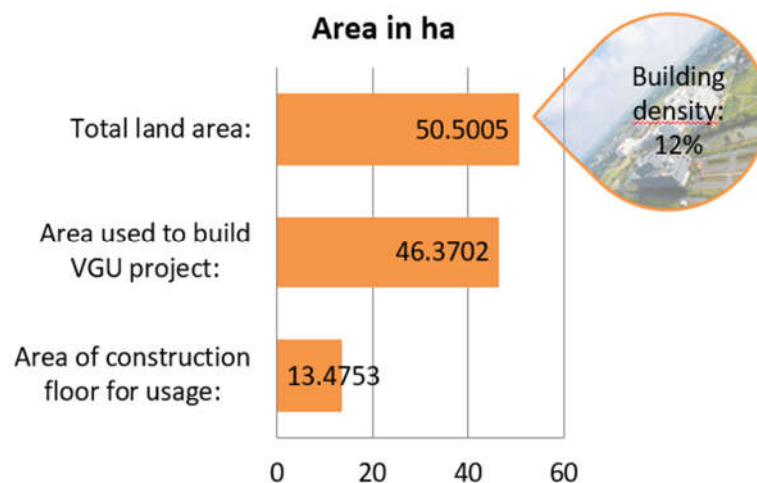


Figure 3: Building area of the VGU new campus



Figure 4: VGU new campus

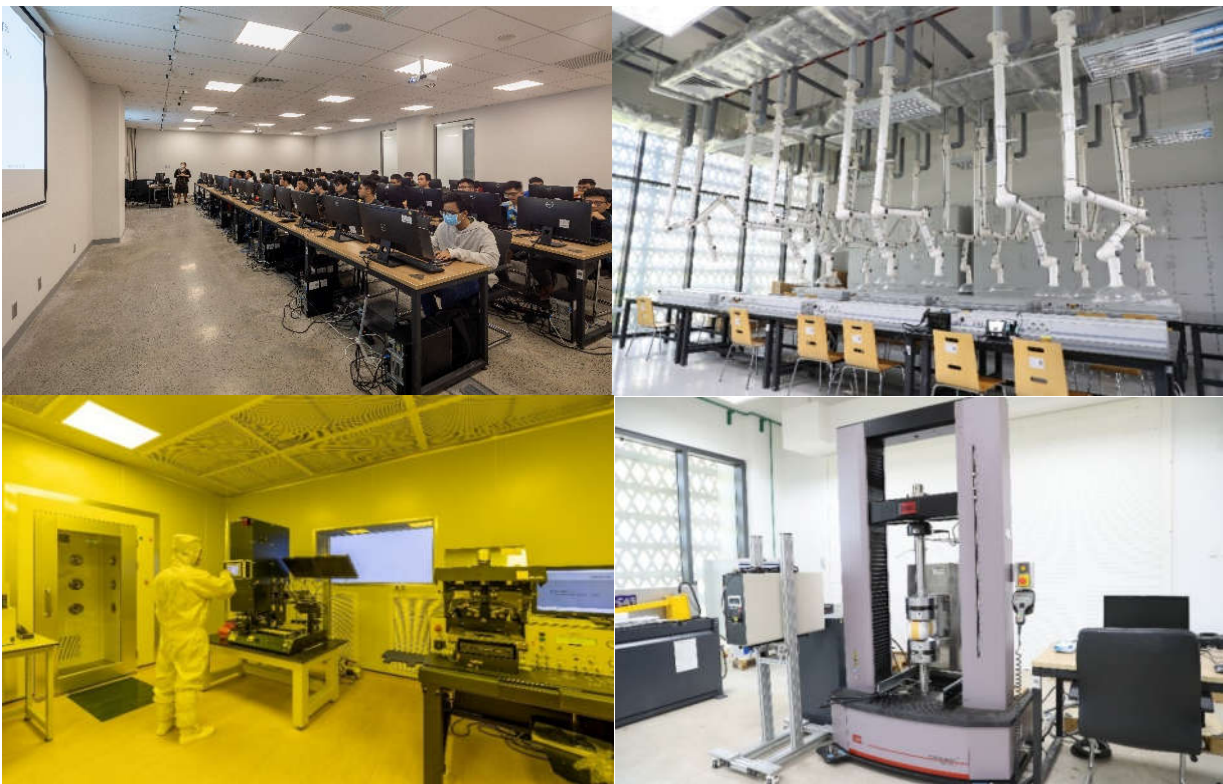


Figure 5: VGU Labs

1.3 Sustainability

Sustainability is one of the organizational values and the strategic direction of the VGU. The institution aims to become a leading research university in Southeast Asia and the first choice for students and academics in the fields of smart engineering, information technology, business and economics in Vietnam by 2030. In close collaboration with German higher education institutions and universities worldwide, the VGU will continue educating young people who will shape the global society sustainably.

Two of the three key research groups of the university are directly related to sustainability, namely Production Technology and Sustainable Manufacturing and Sustainable Urban Development and Transportation. There has been discussion to establish another sustainability-related key research group at the VGU with its focus on water technologies and water resource management. What is more, one study programme, namely Sustainable Urban Development (SUD), directly refers to the SDGs. Several other programmes at the VGU, such as Water Technology, Reuse and Management (WTE) or Global Production Engineering and Management (GPE) have various modules included that relate to different aspects of sustainability.

Last but not least, the VGU is active when it comes to supporting the non-academic community. Several outreach activities and projects have been underway or already successfully implemented, such as the research project on “Enhancing flood risk assessment through integration of ensemble learning approaches and physical-based hydrological modeling” which can be utilized as a guide and reference for flood risk reduction and management in central Vietnam, thereby assisting managers, decision-makers, and planners in successfully managing and reducing floods in high-risk flood zones.

2. Sustainable Development Goals at the VGU

2.1 Chosen SDGs



The VGU cares for its fellow students, colleagues, and their families. The university is committed to the SDGs and acts accordingly. Although the VGU is aiming at achieving all sustainability goals, it has laid a special focus on five of the goals as follows:



6 CLEAN WATER AND SANITATION

Clean Water and Sanitation (SDG 6)

VGU optimizes sustainable design from planning for its new campus that addresses water solutions. Most of the wastewater after treatment will be reused for irrigation systems and non-potable water systems (e.g. toilet flush). Free drinking water also is provided on campus and in dorms.



8 DECENT WORK AND ECONOMIC GROWTH

Decent Work and Economic Growth (SDG 8)

In comparison to other public universities in Vietnam, the VGU pays higher salaries and therefore adds to the local economic growth.



10 REDUCED INEQUALITIES

Reduce Inequalities (SDG 10)

The VGU reduces inequalities by giving scholarships to ethnic minorities or reducing tuition fees to enable a higher education for them.



11 SUSTAINABLE CITIES AND COMMUNITIES

Sustainable Cities and Communities (SDG 11)

Different projects and research focus on integrating the VGU into the local community and on making it more sustainable.



17 PARTNERSHIPS FOR THE GOALS

Partnerships for the Goals (SDG 17)

The participation in THE Impact ranking furthers VGU's sustainable development by working towards achieving **all** the goals.

2.2 A selection of indicators at VGU

The VGU is committed to contributing to the achievement of SDGs through its research, education and outreach activities. The following are some of the SDG indicators that the VGU uses to measure progress and impact:

SDG17: Partnerships for the Goals

- **Cross-sectoral dialogue about SDGs**



16 VGU students and 22 AAU students participated in the AAU–VGU Students Summer Workshop for academic exchange in sustainable architecture and urban development



The workshop “Co-housing towards green building standards” gathered 120 students and 16 lecturers from 7 universities.

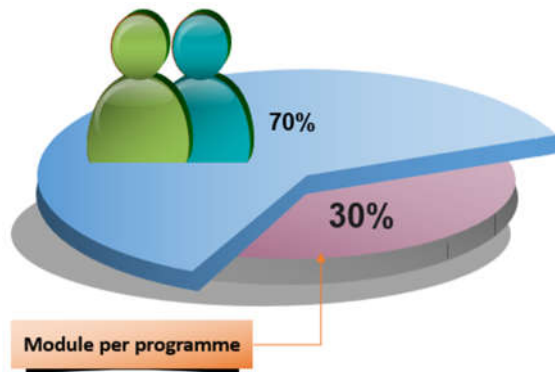
Around 75 people attended the 8th Annual International Conference from Sustainable Urban Development Program (Innovative and Inclusive Growth Models for Sustaining Urban Development) in Ben Cat



121 people participated in the seminar: “Carbon Capture and Storage (CCS) – Just another end of pipe technology or an important contribution to climate protection?”



- Education for SDGs - specific courses on sustainability



- average of 30% modules per program address sustainability and the SDGs



SDG11: Sustainable Cities and Communities

- Promote sustainable commuting



12% university members who use public transportation besides the VGU shuttle bus

- Local authority collaboration regarding planning and development



Project on Assessing water quality, contaminant load and water management solutions in Ba river basin, Gia Lai province



Project on solving traffic congestion in Da Lat city until 2025 vision to 2035

SDG6: Clean Water and Sanitation



Volume of water used in the university buildings per member is about 1.8m³/person

SDG4: Quality Education

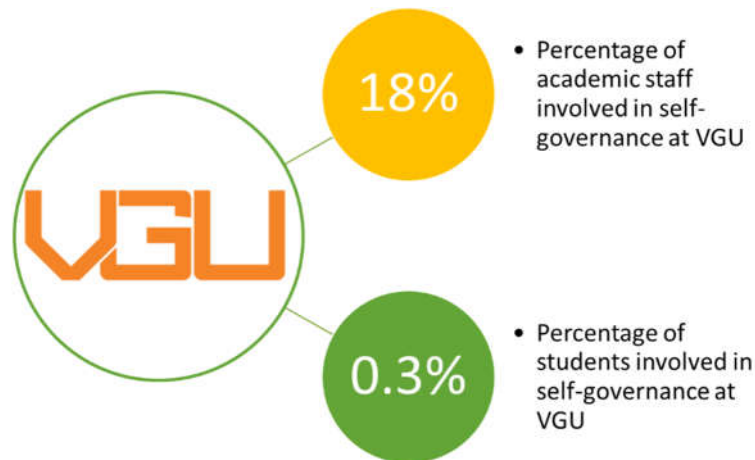
Public events (lifelong learning)

There were 4 public lecturers from MST, GPE, SUD, and WTE program in 2022 with 20 to 45 participants.



SDG16: Peace, Justice and Strong Institutions

- Elected representation



- Participation in government research

2 policy-focused research projects collaborated with government departments



Study on forecasting the demand for public parking areas and proposing planning solutions, investment policies and management modality to exploit the public parking system in central TDM, Thuan An and Di An, Binh Duong province



Public transport service quality: Policy prioritization strategy in the importance-performance analysis and the three-factor theory frameworks

3. Engagement for VGU's Stakeholders

There were several activities and events concerning sustainability that the VGU offered including workshops, webinars, surveys, Green Day, Sport Day.... These were designed to provide opportunities for dialogue, collaboration, and learning among the university's stakeholders and its staff and students. Some of the events were as follows:

Project “Performing towards the Sustainable Development Goals: Multiplying Knowledge in Vietnam Higher Education Institutions”

➤ Objectives

The project aimed to achieve several objectives. Firstly, it sought to disseminate information about the project and raise awareness about the importance of Sustainable Development Goals (SDGs) and university ranking. Additionally, it aimed to encourage other Vietnamese universities to participate in global ranking by adopting SDGs. The Library - Information Center (LIC) provided support, if requested, by offering guidance on how to initiate and proceed with ranking, as well as by organizing training sessions to enhance students' understanding of SDGs and university ranking outcomes. The LIC also proposed incorporating this approach into development skill programs, with special topics and methods. This would help students and high school learners develop their personal skills and knowledge, enabling them to identify and select reputable universities with sustainable development practices. Furthermore, the project would inspire other educational institutions and career centers to integrate this topic into their career counseling campaigns and development skill activities, which have previously received little attention in Vietnamese educational institutions.

➤ Abstract

There are around 500 universities in Vietnam and half of them are colleges. However, only some of them got ranked, for example, 7 with THE World University, 4 with the Young University, and 11 with QS AUR in 4/2021, 6/2021, and 3/2022 respectively. The Vietnamese-German University, a young university, has stepped into the University ranking recently. The project started in October 2021 to firstly overview possible rankings. By extensive analysis and literature review, we assumed that the useful and feasible ranking for VGU to pursue at the current stage is THE (Time Higher Education) Impact Ranking system, which aims at showing how the global higher education sector is working toward the United Nations' Sustainable Development Goals (SDG's). In February 2022, individual meetings of SDG groups were set to discuss the indicators and pre-data collection. The project is in the phase of data collection, and the application with supporting documents is intended to be submitted to THE Impact in 2022. The proposal on “Performing towards the Sustainable Development Goals: Multiplying Knowledge in Vietnam Higher Education Institutions” can be considered as the following-up work in which we organize a series of workshops for high schools and other universities in Vietnam under the Share Peer Multiplier Training program. Through these activities, insightful information and related lessons learned can be disseminated widely so as to increase the perception of university staff about ranking participation, interpretation, and its importance and to help high school and preparatory students and those who want to register 2+2 study programs to select the right university in the future.

➤ Outcome

From 19th August to 21st October 2022, LIC delivered four workshops at two universities: Can Tho University and Dalat University. Some other universities found the workshops relevant to their needs

and joined our workshops online. The hybrid workshops were conducted in the morning sessions for university staff.

Workshop outcome for university staff:

On the first topic, we invited Ms. Jessica Wang - Strategic Solution Manager to share with the participants the contents about THE Impact Rankings, including a Methodology overview, an analysis of national and regional trends, sustainability and reputation and how to submit to THE's Impact Rankings 2023. Moreover, a deep dive into the data and benchmarking, powered by THE DataPoints also was introduced.

The second topic is, one of the most challenges when joining the Impact ranking is to know how to submit and which kind of data, how to select data wisely for successful submission with a high score. To deal with such challenges, we invited Mr. Nguyen Duc Anh Nghi and Ms. Tran Thi Nguyet Suong - LV&F HE, ranking experts to explore data collection and its process, a case of successful participation at THE Impact Rankings. The contents were delivered to the audience are where to start with Impact ranking, definition of SDGs and which SDGs should be preferred, how to collect data and what kinds of data should be collected for submission. All questions concerned by the audience were addressed in the Q&A session. After that, the certificates were presented to the participants. For those who joined online, we delivered e-certificates to them.

To renew the contents of the workshop at Da Lat University, we invited Dr. Sorngate from Chulalongkorn University, who worked directly on university ranking strategies to share her experience about how Chulalongkorn University is successful, “on top” with many rankings, and resource structure in the QA office at Chulalongkorn University.

The world has been towards Sustainable Development, and each country has been putting this on its national development strategies. Hence, the most important thing the project benefits the participants is to bring knowledge, help them understand more clearly about Sustainable Development Goals and take their attention to this topic. The survey results indicated that over 90% of participants were satisfied with the speakers' and workshops' contents and performance. They most agreed that the workshop provided them with more knowledge about SDGs and approaching global rankings. These results contribute to the achievement of the project objectives.

❖ *Media post for university workshop at Can Tho University: [website article](#)*



Figure 6: Workshop at Can Tho University (for staff)



Figure 7: Workshop at Da Lat University (for staff)

Workshop outcome for university and high school students:

On the same day of the workshop for Can Tho University (19/08/23) and Da Lat University (21/10/23), we also conducted workshops for university students. The name of the workshop is “Performing Sustainable Development Knowledge, Sustainable Career Choice and Global Citizens”. The speaker shared his experience with career choices associated with SDGs, how to become a global citizen. The students have fully grasped the concept of SDGs and career trends. Moreover, the speaker shared with them tips and action plans for preparing skills and other necessary knowledge for their career trajectory, to help increase students’ personal brand name in the labour market. We designed the content embedded in the game such as quizzes and a “wheel of name” to make the sharing content more interesting and engaging for the students to remember knowledge about SDGs.

According to the post-survey, students said that they were satisfied with the speakers' quality and the core value that the workshop brought to them. 91,1% of students informed that the workshop was helpful for their sustainable career trajectory, 93,4% believed that the workshops provided them with new knowledge about Sustainable Development, and 100% of participants were satisfied with the workshop's quality.

For two high schools Hung Vuong Gifted School and Viet Anh International High School, workshops taken place on 14/09/2022, the same topic from university students' workshops was applied. In addition, our speaker expanded the topic to "gratitude" for the parents. Amazingly, the sharing touched all participants' hearts. We could see many teardrops in the workshops. The Principals of the schools expressed their "gratitude" to us, to SHARE, and to the speakers about what we brought to their students who are at the age of rebellion.

We do believe the core value of the workshop that was funded by SHARE is beyond the expected outcomes proposed.

❖ *Media post for the workshop in high schools: [Viet Anh International High School Facebook](#)*



Figure 8: Workshop at Can Tho University (for students)



Figure 9: Workshop at Dalat University (for students)



Figure 10: Workshop at Viet Anh International School



Figure 11: Workshop at Hung Vuong Gifted High School

➤ **Impact**

The research results assumed that most of Vietnamese Universities wish to join the global rankings, however, approaching the SDGs or information about university rankings is limited. In addition, language barrier is also considered as a disadvantage when they found it hard to approach THE rankings themselves. Therefore, such disseminated workshops implemented will be a good chance for the university community to know more about SDGs and University rankings.

100% of university students and young learners have not known about sustainable development knowledge. Keep going this activity will help solve the issues of the graduate's un-employability in the future because they will have clear personal plans for their sustainable career trajectory. Learning to know SDGs also helps university and high school students adapt to the world and be global citizens. THE Impact Rankings and SDGs will be disseminated and implemented in the wider communities and areas in Vietnam, even remote areas.

SDGs will be integrated into the priorities and strategies of a university given that approaching SDGs has become the national action plan which must be achieved by the 2030 Agenda (Vietnam SDG target (VSDGs) assisted by United Nations Development Programme and approved by the Prime Minister in 2016).

The SDG Pavilion at the 27th United Nations Climate Change Conference (COP27) on 7th to 18th November 2022 in Egypt also brings experts and policymakers worldwide, including Vietnam. The action plan called for climate change and SDGs aligned with the 2030 Agenda and Paris Agreement. Therefore, getting SDGs knowledge under approaching SDGs in THE Impact Rankings and its implementation will be an unescaped part of Vietnam HEIs.

Green day 2022: Vietnam Clean-up Day 2022

Vietnam Clean-up Day 2022 was initiated by Actions for Climate Change and Biodiversity (ACCB) with the desire to contribute to building a greener and cleaner Earth. ACCB is a non-profit initiative that connects communities to take action to prevent climate change and biodiversity decline. The initiative

is also designed to help accelerate the achievement of the Global Sustainable Development Goals, with a focus on SDGs 2, 13, 14, 15... On 03/06/2022, our VGU GREEN Inspiration group managed to collect 250 kilograms of waste and donated 150 kilograms of clothing. The normal waste was transported by provincial workers to the landfill station, whereas the recyclable waste was collected by the cleaning staff to be sold to the recycling agencies. The books we collected were sent to pagodas, which delivered them to remote areas for children or pupils. Clothes were distributed by charity organizations to the highland areas and nearby pagodas. The pagodas helped to deliver clothes to the needy areas and people, charity centres and low-income workers.



Figure 12: Clean-Up Day at VGU with Dean, VGU staff and students

We also introduced sorting bins to VGU campus, including a battery bin. The collected e-waste was sent to the “Vietnam Tái Chế” (Vietnam Recycle) Agency and to Vinmart, where they collect the e-waste and send it to the respective disposal landfill.



Figure 13: Waste bin – Recycle bin – E-Waste bin on the Library ground floor

On our new campus in Ben Cat, therefore we established this donation station on the library ground floor to encourage regular clothing and book donations. The items collected from this box will be sorted out and given to other charity organizations or pagoda staff, who will then hand out these items to children who live in remote areas and don't have access to these items.



Figure 13: Donation box for clothes and books on the Library ground floor

Workshop on sustainable living

On the 09/06/2022, the GREEN Inspiration group invited three professional yoga instructors who gave a workshop on sustainable living. The topic was "Green actions for a healthy lifestyle, inspiration and sustainable development," which focused on how much nature impacts the lives of everyone and the way nature is exploited and polluted using soap as an example.

The participants were given the opportunity to learn about sustainable products and packaging. The workshop began with Dada Karmayogananda, one of the yoga teachers, who shared some ideas on how to live healthier, simpler and greener. He was followed by another yoga teacher, Mr. Didi Priyainjali, who showed the participants how to keep calm, mindful and healthy. An Ban group, the last facilitating group showed us how to connect with nature by mindful breathing, mindful eating and mindful walking. In the end, the participants made quality soap by themselves. The representative of the group gave tips on how to reduce garbage, packaging and chemicals in daily life. By giving the students the soap made with the instructor, we hope that they will remember the lessons and associate sustainability with positivity rather than renunciation.

❖ [Link for posts: VGU Green Inspiration - Home | Facebook](#)



Figure 14: Go Green with healthy lifestyle workshop

Blood Donation Day 2022

As well on 03/06/2022, "Humanitarian Blood Donation Day" was organized by the Red Cross Association of Binh Duong province in collaboration with the Student Association of Vietnamese-German University (VGU). Many VGU staff and students participated and supported successfully. Donating blood is a noble gesture that demonstrates the tradition of mutual affection and compassion, loving people as if we love our own people, an act of helping sick people who are in need of precious blood drops to maintain life. VSA would like to express its gratitude and sincere thanks to all the students who participated and contributed to the successful and meaningful "Humanitarian Blood Donation Day".



Figure 15: Blood donation day VGU on 03/06/2022

Sport day 2022 at VGU

On 17/12/2022, VGU joined Binh Duong province to organize the "Binh Duong Provincial Running Tournament 2022" with the theme "We run - We share". The tournament was a great success with enthusiastic participation from VGU students and contestants from all over Binh Duong province. The tournament was to improve the health and fitness of runners - especially the younger generation, connect people with people, and raise charity funds for the community.



Figure 16: Running and walking tournament "We run - We share"

4. Teaching for Sustainability

4.1. Sustainability in degree programmes at VGU

There are several modules in VGU's degree programmes that address sustainability and the SDGs at the university. VGU's students are supposed to have a better understanding of the importance and relevance of sustainability in their academic and professional endeavors, and how they can contribute to a more sustainable future.

➤ **Water Technology, Reuse and Management (WTE)**

WTE is a Master program that has many modules that contribute knowledge and case studies for SDG 6: Clean Water and Sanitation. These modules are:

Drinking Water

The study content are the legal frameworks of water quality in Germany, Vietnam and of the WHO and EU. The water quality framework includes many parameters in hygienic, physical, the quantity of water consumption and strategies for saving it. Students also study about the water resources, water treatment technologies, how water is distributed and storage....

Economics of Infrastructure

Students will learn about the system of urban infrastructures, their dependencies and methods of economic evaluation. The system of infrastructure course provides students with a coherent understanding of infrastructure systems and their economic background. Technical and social infrastructures, such as water supply, sewage disposal, electricity supply, waste disposal, transport facilities or educational facilities, are essential prerequisites for the sustainable development of a city. At the same time, they are socio-technical and socio-economic systems with a large number of stakeholders and intensive dependencies between the individual parts.

On the other hand, economic evaluation methods provide students with the basics and the application of common economic evaluation methods for environmental assets.

Flood Management

This module provides an understanding of flood hazards, flood Impacts and flood risk management. The students will learn the cause-effect structure of flood events. They will be familiar with different strategies and measures for flood protection. They will know which methods can be used to allocate measures and be in a position to develop protection concepts adapted to the site conditions.

Interdisciplinary Project

In this module, the students will experience a training method of integrated research on water treatment, water reuse, and water management in form of a case study.

The course will enable the students to work with technical solutions by using the different processes they have learned during the study program. They will be able to combine several economic, ecological and social aspects of the solutions to get a sustainable planning result as well as to realize these results.

Municipal Wastewater Treatment and Reuse

Study contents include fundamentals of wastewater treatment, mechanical wastewater treatment, biological wastewater treatment, sludge treatment, system analysis.... On successful completion of this module, students will be able to operate and maintain environmental plants concerning technical,

economic and ecological issues. They will be able to evaluate different solutions, explain them in an objective and understandable way, and take appropriate decisions.

River Basin Management

The course provides students knowledge of anthropogenic impacts on hydrological processes, soil erosion and sediment transport, land use and climate change, ecosystem-based adaptation.... to enable them to explain and assess hydrological processes, measurement and modelling approaches, and the impact of measures. Students will be able to analyze and evaluate case studies on integrated water resources management.

Spatial Planning in Flood Area

The module aims to provide the students with a wide range of knowledge on spatial planning concerns in relation to urban flood issues, especially with a focus on land-use in flood-prone areas, flood-adaptive urban design at the neighborhood scale, and building typology and design in the context of the flood.

➤ **Business Information Systems (BIS)**

The BIS program offers students comprehensive business and management frameworks that foster sustainable development. By engaging in hands-on sessions, students consistently incorporate sustainability as a critical factor when formulating decisions and implementing their business models.

IT Business Model and Innovation Management

In this module, the learners will be introduced to design thinking, business model canvas and business model generation, and learn about different business models and sustainable business models. Sustainable business models are all about identifying how companies cannot only generate value for themselves and their shareholders but also how they can create value for all stakeholders, such as society and the environment.

Management Sciences and IT-based Decision Making

This course applies quantitative methods (models) for problem-solving and decision-making. It aims to give the student an understanding of how to use advanced optimization methodologies to formulate, solve and analyze decision problems in industry and business (logistics, human resources, production, etc.). Through several case studies which also include sustainable development models of resources of particular industries, the students are given an understanding of the differences and similarities between models from different industries.

➤ **Global Production Engineering and Management (GPE)**

The GPE Master program has several modules related to sustainability across its module groups, which refer to SDG12: “Responsible Consumption and Production”. These modules are:

Manufacturing and Factory Planning

The course includes selected topics of manufacturing and factory planning such as product and process innovation, sustainable manufacturing, energy management... The main goal of the course is to strengthen the entrepreneurial thinking of students. The three levels of sustainability are addressed.

Learning Factory

The course includes the following topics: Methods and practices of lean management, logistics and quality management, performance management, key performance indicators, and change management. Students will gain state-of-the-art knowledge about value creation, factory elements and operations management. One focus is laid on production planning and control.

Additive Manufacturing

Additive manufacturing (AM) has become one of the most important technology trends for systematic product development. Besides learning concepts, processes, and methods in AM, one of the main contents of the course are materials for the AM technology and sustainable design for AM.

Systematic Product Development

The objective of the lecture is to provide knowledge and skills for the use of methods in the early stages of the design process. In particular, the topics that will be discussed are product planning, task clarification and problem statement, interrelationships in technical systems, quality function deployment, solution finding methods, selection and evaluation methods... Of course, sustainable solutions will be taken into account in the solution and evaluation stage.

Quality Management

The most important quality requirement of processes is described by the statistical basic standards of the process capacity. Therefore, the curriculum focuses on the Set of Standard Specifications ISO9000 and following, specific standard specifications, which set requirements for the quality management system of organizations. A part of the curriculum is devoted to “Quality and the term: economical”. The content of the course also includes quality and the term “ecological” as well as product liability.

Technology and Innovation Management

The course focuses beyond the overall relevance of innovation for organizations, regardless of the organization’s focus on production and service activities. Topics such as product-service systems and its relation to sustainability, circular economy, value proposition, lean innovation, innovation dilemma, portfolio management and dynamic capability are addressed.

➤ Architecture (ARC)

Although the ARC Bachelor program does not have many modules specifically related to sustainability, the architectural approach generally aims for it. Two modules which are most relevant to SDG 13: “Climate Action” are Building Climatology I & Building Climatology II.

Building Climatology I

The module takes up aspects of energy-optimized buildings and includes further aspects of sustainable construction. The students will acquire basic knowledge of the building climate. They will also possess the basic ability to design and dimension buildings and their components with regard to damage-free, climate- and use-oriented and energy-efficient construction. Moreover, students will know what requirements are placed on new and existing buildings regarding their energy efficiency and sustainability.

Building Climatology II

In this module, the building climatic expertise is deepened, taking into account current research results. The students will know the influence of location, building form and function on energy efficiency.

➤ Sustainable Urban Development (SUD)

Besides some modules which focus on basic skills such as Academic English Writing, Geographic Information System, Methods of Empirical Analysis, and Urban Construction, the SUD Master program was designed to serve sustainable development goals such as SDG11: Sustainable Cities, SDG15: Life on Land and SDG17: Partnerships for the Goals. The modules relevant to sustainability are:

Vietnamese Property and Planning Law

The module helps the students to understand the Vietnamese and German legal systems and their roles in the planning and managing of urban development. Students will understand legal and humanistic approaches to address human settlement and sustainable development issues.

Urban Development and Architecture of Cities

The course will provide the students with knowledge on urban planning, urban design and architectural and typological aspects of cities. The students will know about the main challenges of sustainable development and construction, and they will be able to assess planning based on different instruments and procedures.

Instruments of Spatial Planning

The content of the study are the definition of spatial planning, principles, case studies, Environmental Impact Assessment (EIA), and Strategic Environmental Assessment (SEA) in spatial planning, etc. The students will also learn about the ecological, social and economic fundamentals of spatial planning as well as about the major constraints of sustainable urban development.

Urban Transport Planning

The module contains an introduction of urban transport systems, sustainable transport policies, smart mobility management and Traffic Impact Assessment (TIA).

Development Planning and Governance

The course aims to provide learners with a comprehensive understanding and heightened awareness of the legal and institutional frameworks that govern urban development processes. By examining the engagement of various stakeholders in modern society, the course facilitates discussions that shed light on the intricate dynamics of power and decision-making. This exploration of power dynamics helps uncover how state entities, local communities, and developers navigate conflicts of interest within urban development. By delving into these complexities, the course emphasizes the importance of sustainability in urban development. It highlights the need for a balanced approach that considers the long-term social, economic, and environmental impacts of development decisions.

Urban-rural Partnerships

The module provides knowledge about the various roles and responsibilities of rural functions in metropolitan development in a holistic way, and with the skills and abilities to respond to changes. Students will explore the roles and contributions of the cities to rural development and emphasize their impacts on the rural areas. Students who successfully complete this module will be able to use valuation methods for the ecosystem and its services that are important for sustaining both urban and rural zones.

Urban Infrastructure

Students will learn about the system of urban infrastructures and their dependencies as well as about solid waste management. Technical and social infrastructures, such as water supply, sewage disposal, electricity supply, waste disposal, transport facilities, or educational facilities, are essential prerequisites for the sustainable development of a city. At the same time, they are socio-technical and socioeconomic systems with a large number of stakeholders and intensive dependencies between the individual parts.

Multi-disciplinary Module

This module provides many case studies for the students to develop in small groups ideas for sustainable urban development of a confined area of Ho Chi Minh City according to land use planning, green buildings, technical and social infrastructure. The course will enable the students to work in a complex urban development process by using the methodologies they have learned during the course of the study program. They will be able to combine several economic, ecological and social aspects of an urban sustainable development to get a sustainable planning result as well as to realize these results.

Economic Assessment and Life-cycle Assessment Methods

The first part of the module provides students with the basics and the application of common economic evaluation methods including economic valuation methods for environmental assets. The second part of the course quantifies all relevant emissions and resources consumed and the related environmental and health impacts and resource depletion issues that are associated with any goods or services along its whole life cycle: from the extraction of resources, through production, use and recycling, up to the disposal of remaining waste.

Ecological Management

The module aims to provide the students with a wide range of knowledge on the ecological system and its relation to city development through which the students will know how to manage it in the context of urban complexities and dynamics. These include matters of shrinking and growing cities in relation to the ecosystem, environmental issues and management agendas, urban green and its particular importance, sustainable urban development towards eco-cities, ...

➤ **Global Finance and Economics (GFE)**

GFE is VGU's new Master program that opened in 2022. The course **Advanced Topics in Survey Methodology and Impact Evaluation** will be offered in summer semester 2024 for the first time. GFE will discuss with the respective lecturer to include one section on evaluating the impact of sustainability policies on economic growth and firm strategies.

4.2. Workshops related to sustainability at VGU

There were two workshops related to sustainable development organized by the ARC faculty in association with other universities in the region: Students Summer Workshop and Green Summer Design Studio 2022. The workshops gave the participants a great opportunity for practicing and academic exchange in sustainable architecture and urban development.

AAU – VGU Students Summer Workshop 8-9/2022

➤ **Purpose**

The workshop created an opportunity for academic exchange in sustainable architecture and urban development. Architectural students of Vietnamese-German University (VGU) had a study tour in

Bangkok and a design workshop with students of Montfort del Rosario School of Architecture and Design, Assumption University (AAU). Remarkably, several activities in the workshop enhanced students' knowledge in approaching sustainability. Firstly, the students have experienced the urban development of Bangkok, self-explored and discovered some key points of sustainable urban development. Secondly, students have learned from the lectures of the two universities' professors, VGU and AAU, on architectural design associated with the community's sustainable development. Lastly, students applied knowledge and participated in a quick design activity set in a real-life context in the Ari district: improving the living environment of residential settlements on a neighbouring scale.

➤ **Description**

This activity aimed to create opportunities for academic exchange between students of VGU and AAU, focusing on knowledge about design orientation to improve public spaces associated with the sustainable development of residential communities at the inner district scale. The activity attracted the participation of 16 VGU students and 22 AAU students from both schools' Architecture programs, taking place from August 22nd to September 3rd, 2022.

From 28th to August 30th, students visited typical modern architecture. They experienced the development of Bangkok urban, combined with visiting historical buildings such as the ancient capital Ayutthaya, Thailand Royal Palace, Wat Pho Pagoda, etc., to gather more knowledge about sustainable urban development and preserve architectural and cultural identity in urban areas.

From August 31st to September 3rd, students participated in a quick design activity to renovate Ari Park and the Public Relations Museum into the heart and place of the communities. The design project intensively explored the unconventional possibilities and hidden potentials in making better places, environments, communities, and ways of life in the Ari district. The project outline focused on park space surrounding the heritage building, Public Relations Museum, by firstly enhancing the connectivity between the neighbourhoods, government sectors, and the park as well as secondly generating the park and building programs to attract more users and communities, and lastly revitalizing the park spaces and resurrecting the heritage architecture.

Through study methods such as city tours, observations, lecturing, surveying and design activities, this workshop provided an opportunity for architecture students to apply their knowledge and skills to explore innovative design solutions to answer realistic and complicated situations within a limited timeframe. Students also had a great chance to work as a collaborative team to discuss and exchange knowledge and experiences as well as to enhance their soft skills in design, production, and presentation activities.



Figure 17: Lecturing time at AAU



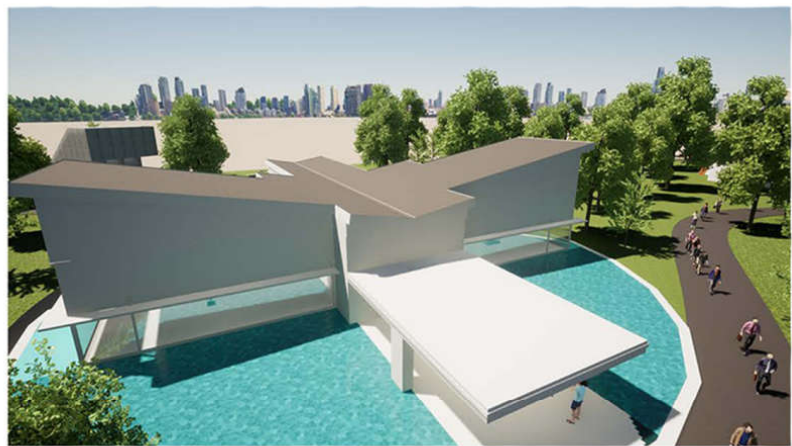
Figure 18: Mixed group of VGU and AAU students when working



Figure 19: Group photo in front of Assumption University, Suvarnabhumi Campus

➤ **Outcome**

Students have gained more knowledge about architectural design in the context of sustainable urban development – architecture for the community/ architecture for humanity. Six student groups’ design products were considered as the initiatives that would eventually ignite better changes in the whole community of the Ari district. The design proposals addressed these issues: (1) enhancing the connectivity within the neighbourhoods, (2) generating the park and building programs to attract more users, and (3) revitalizing the park spaces and resurrecting the heritage architecture.



Studio Members

Instructor
Aj. Miguel

Students
Seub Wattanavisankul
Thaw Zin-
Jessica Pailin Immel
Nguyen Vu Minh Thu
Le Hoang Ky
Hoang Huu Nhan

PhumKetaaPark

Studio Synopsis

Project to renovate Phum Keta park, and create more surrounding spaces include meeting area, cafe, vinyl library, theater, playground and pavilion. Based on the sponge city concept, our team attempts to address the issues and surroundings that are present and develops events that draw both locals and tourists. As the park's focal point, the museum will also be developed to alleviate environmental deterioration and functional loss.

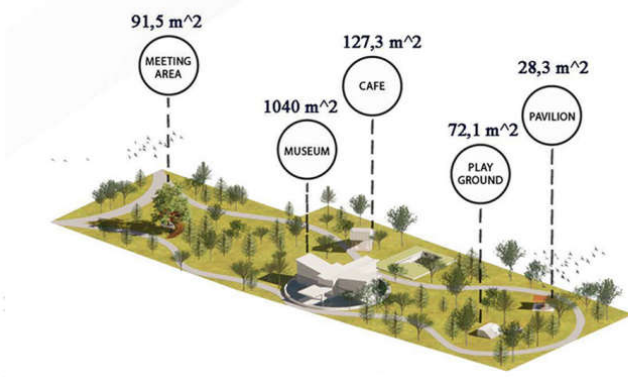


Figure 20: Group 1’s proposal – Most Popular Award – page 1



Figure 21: Group 1's proposal – Most Popular Award – page 7

➤ **Impact**

The workshop has contributed several positive impacts, such as providing valued initiatives for communities in the Ari district for improvement. In addition, the cooperative relationship between VGU and AAU was being strengthened. Furthermore, the network was extended to the Pa Thai Social Enterprises and The Public Relations Department of Thailand.

Green Summer Design Studio 2022: Co-housing towards green building standards

➤ **Purpose**

In the context of potential social changes such as the covid pandemic, the workshop aimed to consolidate knowledge about sustainable architectural design for architecture students. Through the topic of Co-housing Towards Green Building Standards, students were equipped with general knowledge about sustainable development, including the economy, society, and environment. The co-housing model's design helped students have a look at the resilience of a community that a building can bring through common spaces – dimming indoor-outdoor dichotomy and encouraging social communication. In addition, the workshop provided opportunities for students to improve their teamwork skills, find ideas quickly, develop creative thinking, present projects, and interact directly with design consultants, architecture and construction firms, and real estate businesses, creating a good premise for practicing architects in the future.

➤ **Description**

From July 9th to July 17th, 2022, the Green Summer Design Studio 2022 was jointly organized by Architecture Magazine of Vietnam Associate of Architects (TCKT) with universities offering Architecture

programs: Vietnamese-German University (VGU), Ton Duc Thang University (TDTU), Ho Chi Minh University of Technology (HCMUT), Van Lang University (VLU), Thu Dau Mot University (TDMU), Ho Chi Minh City University of Technology and Education (HCMUTE), and Ho Chi Minh City University of Architecture (UAH). The workshop gathered 120 students and 16 lecturers from 7 universities, including 16 students and two lecturers from VGU.

The program has created a new playground of design experiences for Architecture students. With the focus on the design contest with the theme “Co-housing towards green building standard for workers or students in Ho Chi Minh City and neighbouring provinces”, participants had access to knowledge about the three sustainable pillars: economy, society, and environment, specifically designing affordable co-housing for low-income people in the direction of green and sustainable architecture. In addition, the Co-housing concept also encourages social interaction – communication between occupants and households, especially in the context of the world facing a pandemic – which has partly affected rethinking in architectural design.

Apart from the design competition, students visited and surveyed the Diamond Lotus Riverside apartment building, District 8 and dormitory A of Vietnam National University, Ho Chi Minh City. Moreover, students also listened to lectures on green architecture from experts of the LOTUS - Vietnam green building certificate.

➤ **Outcome**

With approaches through observations, surveying, lecturing, and design competition, students applied their knowledge to propose new and creative ideas for flexible living spaces that meet the requirements of function, aesthetics, personality, modernity and identity. Not only that, the proposed living spaces could also integrate several other functions and be highly adaptable in the context of socio-economic potential changes. The workshop has been successful with 15 affordable co-housing proposals.



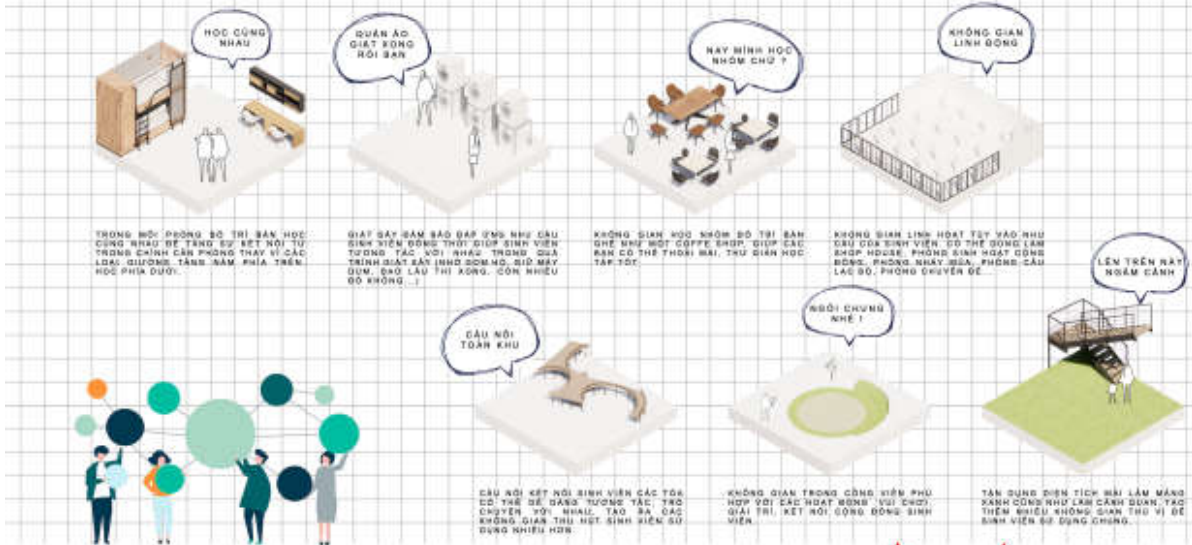
Figure 22: Group 1's proposal – the 1st prize – page 1



Figure 23: Group 1’s proposal – the 1st prize – page 2



CO-HOUSING



GREEN BUILDING

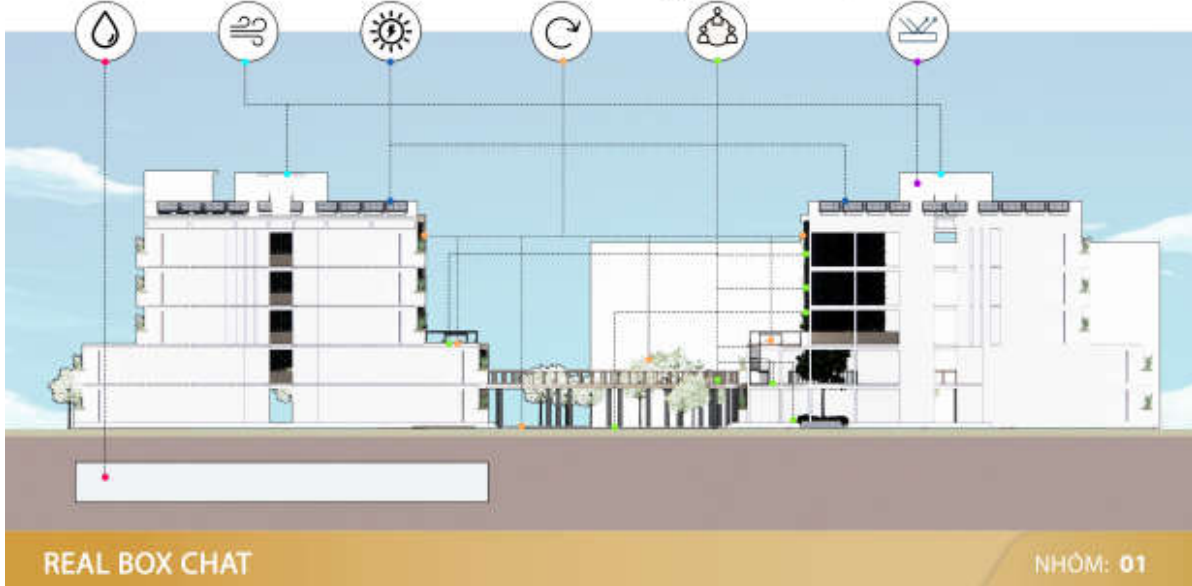


Figure 24: Group 1's proposal – the 1st prize – page 3

➤ **Impact**

The workshop provided numerous advantages, such as suggestive valued initiatives for co-housing models for dormitory A - Vietnam National University, Ho Chi Minh City. In addition, it strengthens the cooperation relationship between TCKT and universities offering Architecture program. Moreover, the workshop has also attracted many architecture, construction, materials and real estate businesses, potentially bringing many funding sources for future events.

5. Research on Sustainability

In 2022, the VGU was actively engaged in conducting research across various SDG areas, with a particular emphasis on SDG 6: "Clean Water and Sanitation". A significant portion of our research efforts has been dedicated to exploring solutions for mitigating and adapting to compound risks caused by climate-human drivers, as well as studying the impacts of measured sand mining and predicting riverbank erosion susceptibility in selected rivers within Vietnam and the Mekong Delta region.

Mitigation and adaptation to the compound risks by climate-human drivers using nature-based solutions in the Vietnamese Mekong Delta (VMD)

➤ Objective

This project uniquely assesses the potential of using nature-based solutions to mitigate/adapt to compound risks. The objectives of the proposed project are to develop compound risk maps due to compound climate-human drivers, quantify the compound climate-human effects on hydrology and agriculture activities in the VMD, mitigate /adapt the impacts of the compound risks via a nature-based solution using floating rice. And finally, to propose an integrated scheme to better exploit floods under future climate change.

➤ Abstract

In a collaboration between the Disaster Prevention Research Institute (DPRI) and Vietnamese researchers from the Vietnamese-German University (VGU) and Thuy Loi University (TLU), our research teams have extensively assessed the historical effect of dams on the Mekong basin on the flow, sediment, morphology, and salinity along the Mekong River's mainstream by analyzing long-term monitored streamflow, suspended sediment concentration, and riverbed bathymetry. We found that upstream dams, especially mega-dams in the Lancang cascade in China, are the primary driver of flow regime alterations, sediment load reduction, and morphological changes.

Consequently, the degraded morphology is responsible for the intensifying salinity intrusion risks in the VMD. There are, however, still some limitations that will be addressed in this proposed project: Firstly, reconstruct streamflow and sediment load over the past centuries or millenniums. Second, the effect of climate change, dam construction, and land use land cover changes needed to be quantitatively distinguished. Third, the livelihood resilience of the local people to the compound risk still needs to be understood. We will develop a compound risk-assessing methodology in this project.

➤ Expected Result

The collected data will be used for long-term research. The research helps to understand and quantify the individual and compound effects of climate change and human activities; furthermore, it establishes dynamic compound flood-drought risk maps to communicate with local authorities and citizens for risk avoidance and mitigation.

➤ Impact

The research gives an understanding of the dramatic increase of compound risks that includes climate and human impacts. We can upgrade our methodology under the compound climate-human effects. It also proposes integrated measures better to exploit the benefit of flood water and sediment while mitigating flood damages.

We will propose and test some hybrid grey-green schemes for sustainable development under the compound effects of flood and drought caused by climate change and human activities.

Enhancing flood risk assessment through integration of ensemble learning approaches and physical-based hydrological modeling

➤ **Objective**

This result purpose is mapping flood susceptibility using machine learning models.

➤ **Abstract**

This study aims to examine three machine learning (ML) techniques, namely random forest (RF), LightGBM, and CatBoost for flooding susceptibility maps (FSMs) in the Vietnamese Vu Gia-Thu Bon (VGTB). The results of ML are compared with those of the rainfall-runoff model, and different training dataset sizes are utilized in the performance assessment. Ten independent factors are assessed. An inventory map with approximately 850 flooding sites is based on several post-flood surveys. The inventory dataset is randomly split between training (70%) and testing (30%). The AUC-ROC results are 97.9%, 99.5%, and 99.5% for CatBoost, LightGBM, and RF, respectively. The FSMs developed by the ML methods show good agreement in terms of an extension with flood inundation maps developed using the rainfall-runoff model. The models' FSMs showed 10–13% of the total area to be highly susceptible to flooding, consistent with RRI's flood map. The FSMs show that downstream areas (both urbanized and agricultural) are under high and very high levels of susceptibility. Additionally, different sizes of the input datasets are tested to determine the least number of data points having acceptable reliability. The results demonstrate that the ML methods can realistically predict FSMs, regardless of the number of training samples.

➤ **Outcome**

The finding of this research is significant to demonstrate that machine learning methods can work efficiently with an acceptable level of accuracy within a small number of actual training datasets. Besides, the results of the machine learning methods showed good agreement with the rainfall-runoff model for flood inundation mapping.

➤ **Impact**

The results of this study demonstrate the potential of ensemble learning algorithms, such as CatBoost, LightGBM, and RF, to provide valuable insights into the assessment of flood risk and support the development of effective flood management strategies.

These results might be utilized as a guide and reference for flood risk reduction and management in this region, assisting managers, decision-makers, and planners in successfully managing and reducing floods in high-risk flood zones.

Hydrodynamics, sediment transport, and morphodynamics in the Vietnamese Mekong Delta: Field study and numerical modeling

➤ **Purpose**

Examine the effects of sediment load reduction on riverbed incision and riverbank erosion, providing important indications for the government to sustainably develop the delta while effectively minimizing the negative impacts.

➤ Abstract

Flow, suspended sediment transport and associated morphological changes in the Vietnamese Mekong Delta (VMD) are studied using field survey data and a two-dimensional (2D) depth-averaged hydromorphodynamic numerical model. The results show that approximately 61–81 % of the suspended sediment load in the Hau River during the flood seasons is diverted from the Tien River by a water and suspended sediment diversion channel. Tidal effects on flow and suspended sediment load are more pronounced in the Hau River than in the Tien River. The results show the formation of nine scour holes in the Tien River and seven scour holes in the Hau River from 2014 to 2017. Additional six scour holes are likely to form by the end of 2026 if the suspended sediment supply is reduced by 85 % due to damming. Notably, the scour holes are likely to form at locations of severe riverbank erosion. In the entire study area, the simulated total net incision volume in 2014–2017 is approximately 196 Mm³ (equivalent to 65.3 Mm³/year). The predicted total net incision volumes from 2017 to 2026 are approximately 2472 and 3316 Mm³ under the 18% and 85% suspended sediment reduction scenarios, respectively, thereby likely threatening the delta sustainability.

The methodology developed in this study is helpful in providing researchers and decision-makers with one way to predict numerically the scour hole formation and its association with riverbank stability in river deltas. Of equal importance, this research serves as a useful reference on the role of water and suspended sediment diversion channels in balancing landforms in river-delta systems, particularly where artificial diversion channels are planned.

➤ Result

We found that the tidal effect was stronger in the Hau River than in the Tien River. Both observed and simulated data from 2014 to 2017 show that the tidal regime has a clear effect on the water level. Scour holes are predicted to be formed at locations of severe riverbank erosion.

The Vam Nao channel has a significant impact on the flow and suspended sediment dynamics of the Tien and Hau Rivers. Therefore, the sustainability and survivability of the Vietnam Mekong Delta can be threatened if the morphology of the Vam Nao channel is degraded.

➤ Impact

The methodology developed in this study is helpful in providing researchers and decision-makers with one way to predict numerically the scour hole formation and its association with riverbank stability in river deltas.

We anticipate that scour holes are likely to continue to cause an increasing collapse of the riverbank in the near future. Therefore, the predicted results can provide useful information for local authorities to actively propose appropriate countermeasures against riverbank erosion. This research serves as a useful reference on the role of water and suspended sediment diversion channels in balancing landforms in river-delta systems, particularly where artificial diversion channels are planned.

Quantifying the impacts of hydraulic infrastructure on tropical streamflows

➤ Objective

Quantifying the impacts of climate change and human activities on flow regime alterations supports regional decision-makers and stakeholders planning for future sustainable water resource management.

➤ **Abstract**

Hydraulic infrastructures, such as reservoirs and water diversion channels, cause altered streamflow worldwide. Therefore, this study aimed to assess the coupled impacts of reservoir operations and water transfer on downstream streamflow over 42 years (1979–2020) for a tropical river in Vietnam, the Vu Gia Thu Bon (VGTB). We also quantified variations in the multi-sub-basin contributions to the water budget associated with hydraulic structure development. Therefore, a semi-distributed hydrological model, SWAT (Soil and Water Assessment Tool), was developed for the entire VGTB basin considering two plausible scenarios: with a dam and without a dam. In this study, reservoirs substantially affected the streamflow during the 2011–2020 period when 12 cascading hydropower dams were constructed in the Vu Gia sub-basins. The cascading reservoirs across the Vu Gia River reduced the annual average streamflow by 28.1% during this period, whereas their influence was augmented by 13.9% at reaches further downstream. In contrast, the local reservoir and flow diversions created on the Thu Bon River resulted in a 6.5% increase in streamflow. The upstream reservoir operation significantly increased streamflow at the midstream stations by 27.8% compared to the no-dam period. The streamflow decreased in the dry season by 5.6% in the Vu Gia sub-basins and increased by 61.7% in the Thu Bon sub-basins. However, the impacts decreased in the wet season by 41.3% due to the operation of reservoirs, in which Dak Mi 4 had the most significant influence. It was found that the water diverted to the Thu Bon River was governed and reduced by the cascading hydropower dams. Therefore, the operation of 11 reservoirs has partially compensated for the lost water in the Vu Gia sub-basins, to which the Dak Mi 4 plant has transferred 19.7 m³/s (14%). Our findings classify the impact of cascading dams and diversion structures and their interaction with climate change.

➤ **Outcome**

Human activities are key drivers of flow regime alterations, affecting the sustainability of downstream communities. Therefore, human activities need to be addressed for sustainable river basin management.

Flow alteration combined with bathymetry changes increases saltwater intrusion hazard/risk and strongly impairs local socioeconomic factors, agricultural production, and drinking water supply.

➤ **Impact**

This study helps regional decision-makers and stakeholders plan for future water resource management issues and contributes to the current literature that uses combined hydrological models, water diversion, and reservoir operation to investigate the implications of the reservoir in hydrological simulations worldwide.

These primary findings presented a good approach for understanding comprehensive cascading reservoir and inter-basin water diversion, which could be used as a reference for other basins worldwide.

A new systematically measured sand mining budget for the Mekong Delta reveals rising trends and significant volume underestimations

➤ **Objective**

Quantifying sand mining budget using remote sensing technique and field survey.

➤ Abstract

The riverbeds of the Mekong Delta are some of the most intensively sand-mined places in the world. However, sand mining budgets remain limited to rough and indirect estimates. Here, we provide the first systematic, field-based estimation of the Mekong Delta's sand mining budget. This budget overcomes the limitations of relying on officially declared statistics and bathymetric surveys of short channel reach. We applied Sentinel-1 radar imagery to monitor the distribution of sand mining activities using boat metrics-driven mining intensity maps correlated with a field-based bathymetry difference map which were derived from two extensive bathymetric surveys conducted in 2014 and 2017. The two surveys cover ~ 100 km in the Tien River, reaching approximately 15% of the Mekong Delta. We then extrapolated the Tien River findings to the broader Vietnamese Mekong Delta from 2015 to 2020 and measured a continuous increase of the extraction budget by ~ 25% between 2015 (38 Mm³/yr) and 2020 (47 Mm³/yr). We estimated a total sand mining budget of 254 Mm³ during the 6-year study period with an average annual rate of about 42 Mm³.

Riverbed sand mining remains a main threat to the Mekong Delta as it contributes to a multitude of other environmental threats including dam construction effects on sedimentation, ongoing subsidence, sea level rise and recurring saltwater intrusion. This study offers a new approach that can be implemented elsewhere to allow for systematic monitoring and quantification of sand mining activities that are vital for assessing future projections on environmental impacts.

➤ Result

Our field-based annual sand mining rates are higher than both official declarations provided and estimates from previous studies which implies that a substantial portion of the sand mining budget remains unaccounted for.

Besides, the results indicate that on average, 42 Mm³/year of sand is being extracted each year and this is causing an incision of ~0.34m (0.06m/year) across the Vietnamese Mekong Delta (VMD) between 2015 and 2020. During this period, the level of sand mining has increased by ~5% per year.

➤ Impact

Riverbed sand mining remains a key threat to the Mekong Delta. This study offers a new approach that can be implemented elsewhere to allow for systematic monitoring and quantification of sand mining activities that are vital for assessing future projections on environmental impacts.

Our new budgets can also assist with the implementation of improved regulatory frameworks for sand mining to preserve a sustainable balance between natural supply and extraction.

Rainwater harvesting system (RWHS) as a potential adaptation strategy for water, sanitation and hygiene (WASH) in the Vietnamese Mekong Delta: a case of Binh Dai, Ben Tre

➤ Objective

The overall objective of this research is (1) the assessment of implementation feasibility and transferability of RWHS as a potential strategy for integrated water management in the study area; and (2) the technical aspects of an RWHS in the study area. Particularly, specific goals to achieve the objectives are (a) rainwater assessment; (b) RWHS concept designs and considerations; (c) cost-benefit analysis of RWHS; and (d) potential recommendations for policy and expansion of uses.

➤ Abstract

Under the impact of climate change and the rising sea level, saltwater intrusion, or salinity intrusion, is limiting freshwater sources in coastal provinces in Vietnam. Particularly, the Vietnamese Mekong Delta (VMD) has been experiencing some of the worst droughts and salinity intrusion in the past decades due to the compounded effects of anthropogenic flow alteration, groundwater extraction, land subsidence, and rising sea level. As a result, water scarcity is increasingly pressuring the local populace to find alternative freshwater sources aside from surface water and groundwater. Rainwater harvesting is one of such alternative practices which have been studied and utilized throughout the world in both developed and developing nations.

However, rainwater harvesting practices in the VMD are spontaneous with ad-hoc implementation and neglected by the local government despite its proven effectiveness around the world if harnessed optimally and efficiently. This thesis aims to achieve two main objectives: (1) the assessment of the implementation feasibility of rainwater harvesting systems (RWHS) (given environmental, socio-economic, and institutional conditions) as a potential strategy for integrated water management; and (2) the design and technical considerations of RWHS in the study area – Binh Dai district, Ben Tre province. Particularly, specific tasks inherent to achieving the objectives involve (a) rainwater assessment in both quality and quantity which will be the basis for (b) RWHS technical consideration and concept layout; (c) cost-benefit analysis of the proposed RWHS; and (d) potential recommendations for policy and expansion of uses.

Given the current mean water demand surveyed among households, a complete rainwater supply given mean catchment is not possible, which necessitates further estimation of optimal demand that locally available rainwater supply could realistically (hydrologically and economically) accommodate. Quantitative analysis of rainwater showed that given the average catchment area of 28.8m² per individual household and an average pluvial regime of 1917mm annually with primary rainfall concentration from May to November, harvestable rainwater can only optimally accommodate a monthly consumption of 3.89 m³ per household with a recommended storage tank capacity of 18.64 m³. Qualitative assessment of rainwater exhibits elevated concentration of Cadmium and micro-organism contaminations that requires adsorption and disinfection process as treatment, thus indicating the treatment modules needed for addressing the issues. For materials, it was determined that galvanized steel for catchment and PVC for conveyance modules (pipes, gutters, downspout, etc...) were most appropriate, while storage unit option could potentially be between steel and plastic depending on costs and, subsequently, economic feasibility.

Furthermore, cross-analysis using the cost-benefit technique and socio-economic analysis from survey results showed gaps between household economic capacity and willing-to-pay for RWHS implementations. Specifically, only 40% of respondents are willing to further improve rainwater harvesting capability despite mean surveyed storage capacity being only 10.1 m³, which is approximately 84.6% below the calculated optimal storage of 18.64 m³. The majority of responses willing to invest (75%) is categorized under the low-medium monthly income bracket (5-10 million VND/month) which is also the category most likely to invest more on RWHS implementation (average 12.5 million VND/month) compared to responses belonging to monthly income bracket of 1-5 million (8 million VND/month) and 10-20 million (10 million VND/month). However, given the investment capital of plastic-based RWHS (45,522,037VND or ~1827€), there is a gap in willingness-to-pay comparative to actual investment cost at market price, which could be mitigated with the recommended minimum monetary incentive starting at 4,626,638 VND/year continuously for 10 years of the proposed lifespan to breakeven with investment cost. Taking into account future increase in

rainfall as a result of climate change, recommendation of a contingent storage increase of 20% is also recommended at the cost of raising minimum subsidy to 5,269,761VND/year for 10 years. An additional recommendation for temporally variable implementation of modular storage capacity is proposed in the event of subsidy infeasibility. However, dynamic cost-benefit analysis of such an alternative cannot be evaluated simply by static valuation method and would be subject to future study like other research aspects where limitations were present.

➤ **Outcome**

With an average rainfall of 1917mm per year with distribution primarily concentrated between May to November, the surveyed mean water demand of 7.5m³, cumulative rainwater and consumption balance would only have a maximum surplus of 0.59m³ during the rainy, which will not be enough to supplement the lack of fresh water during a potential drought during the dry season.

Given the quality assessment of rainwater samples, the treatment process needed was heavy metal adsorption and microbiological disinfection, the most cost-to-effectiveness corresponding modules of which were three-phase GAC filtration and in-line UV disinfection lamp. The general layout concept is top-down, emphasizing on the efficient flow of rainwater while minimizing contaminants and particles from entering the orientable storage layout (vertical and horizontal).

➤ **Impact**

Given the freshwater shortage in the coastal areas of Vietnam, this research provides a valuable source of fresh water for local people under the increasing climate change and intensifying salinity intrusion. The research benefits directly the local community and authorities. The method developed in the research can be transferred to other regions.

Apply remote sensing and machine learning technology to estimate and predict riverbank erosion susceptibility in the Ham Luong River, the Mekong Delta, Vietnam

➤ **Objective**

The project applied remote sensing techniques to estimate the riverbank erosion rate along the Ham Luong River and applied machine learning techniques to establish the riverbank erosion susceptibility map of the river. Solutions to prevent and minimize riverbank erosion and to protect the existing natural vegetation layer are proposed to maintain the natural riverbank protection corridor in the study area.

➤ **Abstract**

Riverbank erosion and its impact on river morphology changing is an important issue that concerned researchers worldwide. The amount of sediment from riverbank erosion is very large, contributing 30% to 80% of the total sediment transported in a river. This amount of sediment also contributes significant natural nutrients to land and plants.

Riverbank erosion is a common serious issue in most river systems worldwide because it causes adverse effects on socio-economic development such as water quality reduction, instability of infrastructures, threatening the safety of residential areas, and adverse changes to ecosystems. There is a great number of drivers causing riverbank erosion phenomena, including climate change, river slope, curvature, flow discharge, sediment load, land mechanic-physical characteristics, sand mining, and covering rate of vegetation.

Riverbank erosion is a natural disaster that usually happens in the long term. It may affect the socio-economic, human health, education, and even politics. Although the impact of riverbank erosion is relatively slow, it leaves lasting consequences on the affected communities and is almost impossible to recover. It may cause losses in properties, lives, and lands of people. Many large and small rivers worldwide are suffering from severe bank erosion.

➤ **Expected Result**

The research provided historical riverbank erosion maps in the Ham Luong River as well as erosion susceptibility maps for warning purposes. Optimized machine learning models to map riverbank erosion susceptibility that can be applied to other similar regions of interest.

➤ **Impact**

The project encourages training the workforce in the field of riverbank erosion, remote sensing, and machine learning and gains research ability of lecturers and researchers at Vietnamese-German University. It also supports the use of cutting-edge technology in disaster prevention activities in Vietnam, provides plausible mitigative measures against riverbank erosion to alleviate the effects of riverbank erosion on society.

The results from the project will provide valuable for stakeholders and authorities to have long-term sustainable management against riverbank erosion.

Assessment of dam impacts on flow, sediment, and morphology of the Sai Gon-Dong Nai River basin

➤ **Objective**

Assess the impacts of dams on flow, sediment, and morphology in the Sai Gon-Dong Nai River system, from which dam impacts are distinguished from the impacts of climate change and land use/land cover changes in the basin.

➤ **Abstract**

Natural river flow regimes produce spatial and temporal variations in environmental conditions, which are crucial to supporting native biodiversity and the integrity of riverine ecosystems. Meanwhile, sediments transported by rivers are the major sources of materials for protecting low land areas from the natural processes of subsidence, alleviating riverine and coastal flooding due to climate change and sea-level rise, respectively, and providing bed aggregates for land reclamation, construction, and export. Currently, more than 47,000 large dams are in operation worldwide. Besides supplying renewable energy, dams have negative impacts on the downstream environment by altering flow regimes and trapping a large portion of sediment loads transported from upper basins. Consequently, downstream regions lack sediment, resulting in morphological degradation which may increase salinity intrusion.

Sai Gon-Dong Nai (SG-DN) River system is the backbone for the sustainable development of Ho Chi Minh, Binh Duong, and Dong Nai by supplying essential freshwater sources for approximately 20 million people. It discharges 32.5 billion m³ of water to the East Vietnam Sea, ranked second to the Mekong River in the South of Vietnam. 106 irrigation dams (total storage capacity ~2 billion m³) and 23 hydropower dams (total storage capacity ~8.6 billion m³), including several cascade dams, are under commission in the basin, all of which occupy ~32.5% of the total water discharge of the river system. The operations of these dams sometimes do not guarantee flood control for large cities such

as Ho Chi Minh and downstream environmental flow. A holistic understanding of the effects of dams on the hydrology and sediment in the SG-DN River system is, therefore, of crucial importance for better water resource management and planning.

➤ **Result**

Human activities such as dams and land use, land cover changes, etc. are key drivers of significant flow regime alterations in the SG-DN river system.

➤ **Impact**

A workshop will be organized where we will introduce and share the research results with the scientific community, students, and the public. We also contribute to training master students in the WTE master program of VGU by employing two master students to assist with the research. We aim at training these students with actual project activities. Students will be trained using comprehensive research methodologies developed in the project. They will be also trained in the procedure to conduct a research project and, more importantly, in writing ISI journal paper(s).

We would also like to raise the reputation of VGU in the region. The results from the project will provide valuable for stakeholders and authorities to have long-term river basin management for sustainable development.

The VGU also had other sustainability-related international and domestic publications in the year 2022. They covered the SDGs 4: Quality Education, 6: Clean Water and Sanitation and 11: Sustainable Cities and Communities

- **Tran Le Luu (2022).** *Study of the treatment of leachate after biodegradation using the Electro-fenton method. Journal Water-Energy-Nexus in the Ecological Transition - Advances in Science, Technology and Innovation.*
- **Tran Binh Dai (2022).** *Health Benefits of Education: Comparative Evidence from Vietnam and Thailand. Sage Open. SAGE Publications.*
- **Vu Anh Tuan, Thuy Linh Hoang, Muhammad Adnan, Nguyen Hoang Tung, Bruno Kochan, Tom Bellemans (2022).** *Modeling and Structuring of Activity Scheduling Choices with Consideration of Intrazonal Tours: A Case Study of Motorcycle-Based Cities. Multidisciplinary Digital Publishing Institute.*



Figure 25: Vice Chairman of Lam Dong Provincial People's Committee presented the award to the winner of the competition "Solving traffic congestion in Dalat City until 2025, vision to 2035"

6. References and Contributors

This report is the result of the collaborative efforts of many VGU lecturers and staff who contributed their time, expertise and insights. We would like to express our sincere gratitude to all of them for their valuable input and support. We hope that this report will serve as a useful resource to introduce sustainability at the VGU and inspire further research and action on the topic.

Study program of Architecture (ARC)

Dr. Le Thi Thu Huong huong.ltt@vgu.edu.vn
Senior Lecturer cum Academic Coordinator

Le Tuan Nghia nghia.lt@vgu.edu.vn
ARC Lab Engineer

Study program of Business Information Systems (BIS)

Dr. Dinh Hai Dung dung.dh@vgu.edu.vn
Lecturer cum Academic Coordinator

Study program of Global Finance and Economics (GFE)

Dr. Le Van Ha ha.lv@vgu.edu.vn
Lecturer cum Academic Coordinator

Study program of Global Production Engineering and Management (GPE)

Dr. Nguyen Hong Vi vi.nh@vgu.edu.vn
Lecturer cum Academic Coordinator

Study program of Sustainable Urban Development (SUD)

Dr. Nguyen Ngoc Hieu hieu.nn@vgu.edu.vn
Senior Lecturer cum Academic Coordinator

Study program of Water Technology, Reuse and Management (WTE)

Dr. Tran Le Luu luu.tl@vgu.edu.vn
Lecturer cum Academic Coordinator

Dr. Doan Van Binh binh.dv@vgu.edu.vn
Junior Lecturer in Hydraulic Engineering

Library - Information Center (LIC)

Ms. Nguyen Thi Kim Tri tri.ntk@vgu.edu.vn
Director of Library - Information Center

Strategy and Quality Management Department (SQM)

Dr. Nadine Vanessa Kegen nadine.kegen@vgu.edu.vn
Head of Strategy and Quality Management
Department

Ms. Nguyen Vo Chi Thuc thuc.nvc@vgu.edu.vn
Strategy Implementation and Process Officer