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Strengthening the 3C Partnership for Sustainable District

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Abstract. A mutual relationship among the 3C partners—Campus, City, and Community—is essential for achieving the Sustainable Development Goals (SDGs). Siam University, as the only higher education institution in the Phasi Charoen district, has been actively collaborating with surrounding communities and the district office for several years. At present, university administrators and faculty members have taken leading roles in supporting local and community development. The UPC4LocalSDGs and the 4Co (Co-Create, Co-Design, Co-Produce, Co-Reflect) Action Model have been developed as a framework for working with the district office and communities, which serve as our social living labs. This paper presented case studies that employed the 4Co action model in the 3C partnership sustainable initiatives. The "Tiny Heroes, Global Saviors" project in Lad Pachi community exemplified an innovative organic waste management approach using black soldier fly larvae to decompose organic waste and develop into a protein-based and laboratory-tested pet food product. The project received the 2024 IGGA Award in the "Benefitting Society" category. In the area of sustainable transportation, the "S-Guard Barrier Pole" was developed to enhance pedestrian safety, particularly for individuals using wheelchairs, while also deterring motorcyclists from driving on the footpath. Most recently, the 3C partners have co-developed a smart, rechargeable electric garbage-collection motorcycle designed for narrow alleys, with prototypes currently being tested in several communities throughout the district.

Keywords:

partnership for sustainability, the 4Co Action Model, social living lab, sustainable district, sustainable transportation

1. Introduction

During the World Conference on Education for Sustainable Development in November 2014 in Aichi-Nagoya, Japan, UNESCO's Global Action Programme (GAP) was launched with five priorities including accelerating sustainable solutions at the local level [1]. Educational institutions thus have a responsibility not only to develop curriculum and provide learning of

contemporary social and environmental issues, but also to increase their involvement with local problems. Due to their roles, universities possess unique resources and capabilities to provide expertise, develop policy, and carry out sustainable development. In other words, not only do universities nurture concerned and active citizens, but they can also contribute to the well-being of the communities and the accomplishment of strategic goals of the city by providing their academic expertise. There is an increasing demand for the university to take the role of being both a responsive and responsible institution. The role that the 2020 Magna Charta Universitatum (MCU), signed by more than 900 universities worldwide until now, defines as "Universities acknowledge that they have a responsibility to engage with and respond to the aspirations and challenges of the world and to the communities they serve, to benefit humanity and contribute to sustainability" [2]. However, achieving these goals requires all sectors and actors working together, integrating their resources, knowledge, and expertise [3]. Partnerships between (University) Campus, City, and Community (the 3C) are thus imperative for the achievement of the UN SDGs by the year 2030.

Recognizing the significance of SDGs, Siam University, Bangkok, Thailand, has integrated sustainability in our 3 pillars for some time and revised our policies in 2024. For instance, the "Sustainable University, Sustainable District" policy was revised to become a model of sustainable university for both sustainability within the campus and the wellbeing of the surrounding communities and Thai society, to promote initiatives and activities that will enhance sustainable development and encourage achievement of the global Sustainable Development Goals (SDGs) with recognition of H.M. the late King Rama IX's "Sufficiency Economy Philosophy (SEP)", and to nurture sustainability literacy, digital and AI literacy, and communication literacy in our students so that they become change agents for the betterment of the campus, communities, and society. The "Action for the Goals Policy" elaborated on our previous 2018 academic committee policy to emphasize active action and partnerships between the University, public and/or private sectors, and communities in our academic, research, engagement, and administration activities. Moreover, the "Siam University Carbon Neutrality 2045" policy was announced in response to the global issue of climate change with such activities as enforcing the 3R (Reduce, Reuse, Recycle) campaign, building awareness of carbon neutrality and provide training in the carbon emission reduction for our staff and students, encouraging the use of alternative clean energy, campaigning the use of public transport and electrical vehicles, and campaigning the use of zero emission vehicles, zoning those powered by internal combustion engines, and limit number of vehicles in the campus [4]. This paper will explore the action model for sustainability activities and the work of Siam University for the well-being of the city and communities with our dedicated partners - the Phasi Charoen district office and the surrounding communities which have become our social living labs.

2. Methodology

2.1. Partnerships for Sustainable Cities and Communities

Higher education has become a driving factor for economic and social development. There is increasing demand for social responsibility, which includes generating benefits for a wider range of stakeholders. Thus, higher education institutions must contribute to the betterment of society, going beyond their traditional role of providing education and research. This includes taking on social responsibilities like addressing economic, social, and environmental issues, and engaging with the community. Accordingly, social responsibility can be implemented by making education more accessible to non-traditional groups through

more flexible learning pathways, embedding in research, through knowledge exchange and co-creation between academics and practitioners to generate knowledge that can address practical challenges, providing service to society, including volunteering, outreach, student engagement, and partnerships with external stakeholders [5]. In addition, three models of university-community engagement have been implemented. The first model views communities as laboratories for university-related research; the second model considers universities as problem solvers for community needs; and the last model introduces how universities empower communities and build local competence. Additionally, we should also keep in mind that a university- or campus–city sustainable relationship encompasses any form of engagement that is considered essential for the benefit of both the university and the city, which can be divided into two distinct types: physical relationship and functional relationship.

Many studies support the notion that the partnership between universities and cities shapes the dynamics of society and the improvement of cities and regions. Filho, et al. [7] argue that collaboration with local, national and international organizations, is the key to making progress in the SDGs at the level of higher education, with the potential to strategically align the university with society, facilitate better communication with the community, and create alignment with local, regional and global agendas, enhance their impact at a local community and shape national policy and contribute to social change as well as contribute to capacity building for sustainable development benefiting the communities and the university itself. UNESCO and Times Higher Education [8] suggest that higher education institutions (HEIs) can contribute to sustainable cities and communities as well as the strategic development of cities, regions, and countries by collaborating with governments, local stakeholders, and citizens to tackle sustainability issues. HEIs can do so by providing human capital, capacity building, research, innovation, enterprises, infrastructure, and specialized services, amongst other engagement activities. Examples of proactive activities of HEIs include partnering with business and governments to develop, validate, and transfer knowledge that addresses major social needs and urban challenges in cities; promoting the sustainable development of the cities by introducing student and academic competitions that address the main problems of cities and become a launch pad for the development of start-ups and spin-offs that contribute to tackle key urban problems of cities; making commitment to the sustainable development of cities and communities by turning their campuses into testbeds for the development of prototypes that have an impact on the sustainable development of cities; collaborating with other organizations in the design and implementation of projects for the improvement of urban spaces as well as building national or international good practice-sharing networks.

Moreover, the United Nations suggest the need for multistakeholder partnership (MSP) for the SDGs which was defined as *"Partnerships for sustainable development are multi-stakeholder initiatives voluntarily undertaken by Governments, intergovernmental organizations, major groups and other stakeholders, which efforts are contributing to the implementation of inter-governmentally, agreed development goals and commitments"* In addition, MSP must aim to move from "traditional development" which requires an ongoing flow of external resources to continue to improve peoples' lives (e.g. through better health provision, education etc.) or to preserve the environment to "transformational development" which aims to transform the unsustainable (in economic, social or natural resource usage terms) situation to a sustainable (or at least more sustainable), ongoing situation. In other words, it attempts to tackle the underlying causes and leave behind a self-sustaining, resilient legacy where little or no further action, and no ongoing external inputs, are necessary [9].

2.2. Attributes for Effective Partnering

Literature review in effective partnering revealed that a key to collaborative action is addressing real and relevant community needs in an inclusive and community-centric way, as well as developing genuine relationships through mutual respect and understanding, which emerge as a result of deep listening and appreciation of people's interests and aspirations. Keeler et al. [10] introduce the Audacious Partnerships Process for transformative sustainability partnerships that expand capabilities and competencies at both the individual and organizational level, thus developing the confidence of individuals and groups to contribute to long-term transformations. The Process was developed based on the theory of change, research, and existing literature on transformative capacity building and partnership development for sustainability, as well as the experience of the CapaCities network, which is an international network of CUPs, on building capacity in cities, universities, and their partnerships to contribute to urban sustainability transformations. The CapaCities network includes: Arizona State University and the City of Tempe, USA, Dublin City University and the City of Dublin, Ireland, Karlsruhe Institute of Technology and the City of Karlsruhe, Germany; Kings College London and the City of Westminster; Leuphana University and the City of Lueneburg, Germany, the National Autonomous University of Mexico and Mexico City, Mexico; and Portland State University and the City of Portland, USA. They argue that "these transformative partnerships require a focus on (and foregrounding of) relationship development and maintenance and an orientation toward transformational and shared sustainability goals. Attention to these specific areas builds the transformative capacity of CUPs. The Audacious Partnerships Process guides participants in designing the structure and function of the City-University partnership around co-defined, shared values and transformational goals. These values and goals are upheld by supporting structures to maintain the healthy functioning of the partnership, which are identified during the process as most critical to the organizations and individuals involved in the partnership. Values, goals, and structures are then reinforced through co-designed and impactful actions, which can be owned by individuals and teams through their roles and responsibilities and which demonstrate the translation of relationship development into practical sustainability-related action, while building transformative capacity. The process was designed to address these factors through a series of facilitated partnership development activities." The Audacious Process includes three stages: building organizational teams, facilitating partnership development, follow-up, and Implementation. Finally, they propose the following recommendations for City-University partnerships (CUPs): urban sustainability transformations require deep and durable partnerships between cities and universities, before creating sustainability-related collaborative projects, City-University partnerships should first formalize and strengthen the relationship between the organizations, the Audacious Partnerships Process can be used by new and existing City-University Partnerships to have important conversations that build more transformative partnerships, and transformative City-University partnerships must address historic and systemic issues, identify shared values across organizations, and agree to specific and measurable sustainability goals they wish to achieve together.

As for effective partnering, the literature review showed that a key to collaborative action is acting on real and relevant community needs in an inclusive and community-centric way. Cohn, Jo, and Aguilar-Gaxiola (eds.) [11] argue that community engagement should build sustainable relationships through trust and collaboration, strengthening community well-being. The process should be enduring, equitable, and culturally sensitive to all participants,

with a shared goal of addressing the concerns of the community. As such, the keys to sustainable relationships include commitment to 1) sharing power (shared decision-making and shared consequences), 2) sharing resources, 3) learning from others (humility), and 4) taking collaborative action. Mundy and Tennyson [12] of the Partnership Brokers Association, identify the following five principles as being particularly valuable: 1) diversity—a commitment to exploring partners' respective motivations and perspectives, 2) equity—which entails engaging power asymmetries in generative ways, 3) mutual benefit–the right of all partners to gain from the partnership, 4) openness–referring to the precondition of trust for viable partnership and 5) courage–the need for partners to be tenacious in working through inevitable challenges. They also point out ten key attributes for effective partnering: 1) a clear understanding between the partners of the word 'partnership', 2) agreement to a shared vision and common purpose, 3) account and allowance being made for individual partners' interests, 4) the co-creation of design, decisions and solutions, 5) commitment to sharing risks as well as benefits, 6) every partner contributes resources (whether tangible or intangible), 7) partners share decision-making and leadership responsibilities, 8) partners commit to mutual/horizontal accountability, 9) partners work together to develop a principled approach to their partnering endeavors, 10) attention is paid to the partnering process as well as the partnership's projects. Such et al. [13] confirmed a common need for "structural and relational components" involving 1) shared power, 2) relational trust, 3) a common language and understanding, 4) adequate resources, 5) leadership that champions collaboration, 6) identification of "win-win" strategies, 7) building capacity through training and knowledge sharing, 8) meaningful community engagement.

As for partnerships arising to meet sustainability challenges and advance the SDGs, some literatures introduce transdisciplinary co-production or TDCP partnerships - partnerships in community settings between academics and community practitioners who possess diverse backgrounds, experiences, knowledge, and skills for shared knowledge production and emphasize the principle of shared ownership at every step of the collaboration, which means shared framing of problems and goals of the partnership, shared management and ownership of research processes, and ownership of related outputs/products [14].

2.3. The 4Co Action Model

Based on the living lab concept, literature review, and our real-life experiences in project-based studies for a number of years, in 2021, we managed to develop two learning for sustainability models – the Triangle of Living Learning Lab and the UPC for Local SDGs. The latter emphasizes partnership between UPC (University-Public/Private sector-Community) or the 3C (Campus-City-Community) and the 4Co action model. The action model is used as a framework in working with the district office and communities. In this model, the UPC or the 3C is developed as a learning community working for local SDGs. All partners must have a shared vision and passion to address social, economic, and environmental challenges or issues, and be dedicated to transforming vision/passion into collaborative execution at all stages, from planning, implementing, and reflecting for sustainability. Each partner has primary roles. The Campus (or university) helps develop policy and projects with the City, provides academic and R&D expertise, and carries out sustainable development activities, while the Community serves as a social living lab for sustainability solutions, offering real-life experience opportunities as well as involving community members directly in development efforts. The Action Model, which is a learning for sustainability component, consists of the

4Co comprising Co-Create, Co-Design, Co-Produce, and Co-Reflect, which can be summarized as follows [15].

Co-Create in the initial phase, the university explores pain points or sustainability issues of the city or community by surveying and deep listening with stakeholders, as well as discussing and co-identifying possible projects that will be able to work together. The selected issues should be relevant to either local needs, national concerns, or the global agenda, if possible. At the end of this phase, team(s) will be identified from each partner, including university staff, faculty, students, staff, administrators, City administrators and staff, community leaders and members. If needed, other public or private partners can be invited. The teams will also identify the core values they want to guide the partnership and the transformational goals they are prepared to work toward.

Co-Design in co-designing, everyone has something to teach and something to learn. The partners will design a project which could be a solution for the SDG issues of the community based on the geo-social-cultural nature and community socio-cultural capitals. In other words, under this model, designing or proposing ideas/products should take into account not only the demands from the market but also the "community identity".

Co-Produce phase concentrates on making a user-driven "prototype" of the product or "blueprint" of activity, which could utilize academic expertise or R&D from the university and related partners. Co-production implies that all partners make decisions together, respecting each other's input in the process of creating, monitoring, commercializing, or utilizing.

Co-Reflect is the product or activity produced as a sustainability solution will be evaluated, followed by refinement of the innovation to improve and fine-tune the product. Feedback and suggestions gathered from all partners and stakeholders will be used for the betterment of the project and to ensure that the community will be able to continue the work after the partners leave the area. In other words, the main purpose of the 4Cos is to ensure that the community will be self-reliant.

3. Implementation of Sustainable District, Sustainable Transportation: A Case of Siam University

Siam University (SU) is located in Phasi Charoen District, which covers an area of 17.834 km2 (6.886 sq mi) with approximately 121,712 population according to data as of January 31, 2024. It comprises 51 communities in 7 sub-districts; namely, Bang Wa, Bang Duan, Bang Chak, Bang Waek, Khlong Khwang, Pak Khlong Phasi Charoen, and Khuha Sawan. These communities serve as our social living labs under the policy "Sustainable University, Sustainable District". Being the only university in the district, SU has been working closely with the Phasi Charoen District Office for a long time, especially during the great flood in Bangkok in 2011. A year later, in 2012, SU set up the Research Center for Community Development (RCFCD) as a spearhead in transforming many communities under the "Healthy Space" project, which focuses not only on the health problems but also on the issue of environmental, social, and economic well-being. Healthy space is a concept aimed at managing space constraints to facilitate the health and well-being of people in the communities. This long-term project was funded by the Thai Health Promotion Foundation and supported by Phasi Chareon District Office. Our pilot project took place in Lertsuksom community. Through participatory learning process among the 3C (SU, the District Office, Lertsuksom community), dangerous and slum-like areas under flyovers in the community were transformed into healthy and safe social spaces for community members. The second pilot project, "Healthy Space and Learning Garden, Siam University", was officially opened on

April 4, 2018. SU (headed by RCFCD), Phasi Chareon District Office, Thai Health Promotion Foundation, and people in the community worked together to turn the waste ground behind our campus into an open public ground for the benefit of community activities such as exercise, meetings, or to seek knowledge from books available on shelves along the wall of nearby residence. The Healthy Space pilot project was very successful and was announced by the Phasi Chareon District Office to become a community development model of Bangkok, which is scalable and implementable in other districts.

Since then, the 3C partnership has been strengthening, and SU works closely with the Phasi Chareon District Office in various projects. Dr. Pornchai Mongkhonvanit, President of SU, was appointed to the planning committee of the Phasi Chareon District. Recently, in 2023, he was also appointed the Chairperson of the Committee for Driving Partnerships for the Development of Phasi Charoen District. In addition, our administrators, staff, and faculty members were also appointed to that committee and other working groups in the projects such as canal development, Greener Bangkok, time bank, Phasi Charoen well-being node, and the Phasi Charoen "Creative District" Project. The latter is one of the flagship projects of the Bangkok Metropolitan Administration (BMA) with the intention to promote local wisdom and soft power for economic betterment and preservation of socio-cultural capital of the area, as well as working on the environmental surroundings. Siam University joined the Phasi Charoen District Office to launch this project at Poonbumphen community. Furthermore, our latest project with the Phasi Chareon District Office is the new garden healthy space at Wat (Temple) Phadu Bang Chak in which Siam University not only helped in building the "15-minute garden" where people can exercise and relax but also dedicated a pavilion and public restrooms. This area is also planned to be transformed into one of the Creative Districts of Phasi Charoen. Many projects for sustainable district and communities initiated by Siam University are well recognized and awarded nationally and internationally. The example is as follows.

3.1. Organic Waste Management in Lad Pachi Community

Lad Pachi is a small community in Phasi Charoen district with approximately 337 residents who migrated from various places. Under strong leadership, the community has managed to work together for the well-being of the community. Many projects were continuously undertaken with the hope that they would lead to a sustainable community through a self-help and participatory approach. It should be noted that the community is now well-organized and is well-known for being a safe and strong community-watch urban area. Siam University has worked with this community for a long time since the launch of the Healthy Space Project in 2012. After the signing of the MoA with the Government Saving Banks (GSB), many projects were initiated. Some are supported by the Phasi Charoen District Office, such as the "Zero Waste Community" project. Lad Pachi received "Strong Community" and many other awards from local, national and international organizations such as the Phasi Charoen District Office, Bangkok Metropolitan Administration, Department of Climate Change and Environment, Ministry of Natural Resource and Environment, and the International Green Gown Award (IGGA) which is partnered with UN Environment Programme, the Association of Commonwealth Universities (ACU), L'Agence Universitaire de la Francophonie (AUF), International Association of Universities (IAU) and the Higher Education Sustainability Initiative (HESI) and Allianz.

As previously mentioned, Lad Pachi has been working on a zero-waste project for some time, but still has problems with food waste and organic waste management. Siam University then initiated the "Tiny Heroes, Global Saviors" project in 2023.

Figure 1. “Tiny Heroes, Global Saviors” Project in Lad Pachi Community
Source: Siam University

After discussing with community members, surveying, and doing some research studies, the Faculty of Nursing, Siam University came up with the idea to use black soldier fly larvae to decompose food waste. The community bought the idea since black soldier fly larvae are not only useful for decomposing waste, but they can be processed into a marketable protein-based pet food to increase income. With the partners from the Government Savings Bank (GSB) in the “Youth for Community Development Project” (funding and financial literacy training), Kasetsart University’s Faculty of Veterinary Technology (laboratory-test for pet food safety), Siam University’s Faculty of Science and Faculty of Business Administration (pet food production and online/onsite marketing) and the Phasi Charoen District Office (waste disposal knowledge), we started the project by educating the community members about zero waste, training on black soldier fly larvae rearing and organic waste separation for feeding. A new waste management approach using larvae to decompose waste was introduced, followed by developing laboratory-tested pet food, package designing, and online sales training. It was found that this value-added pet food product from black soldier fly larvae had directly increased community income by 32.15%. At the same time, the community indirectly benefited from cost savings in waste management, reduced health risks, promoted sustainable practices, and reduced greenhouse gas emissions. Environmentally, the project had cut greenhouse gas emissions, reducing methane emissions by 9,746.10 kgCO2eq by using black soldier fly larvae to manage and repurpose food waste. It also reduced the daily 70 kg of food and organic waste sent to landfills, cutting greenhouse gas emissions from decomposition. Socially, the project has made Lad Pachi a clean, odor-free community. Also, due to the fact that the community is more hygienic, it could indirectly reduce disease risk and improve quality of life for its 337 residents. The zero waste and the use of black soldier fly larvae to decompose organic waste are recognized as an innovative, sustainable model that other communities can adopt. Recently, the Phasi Charoen District Office has chosen Lad Pachi as a learning center for organic and inorganic waste management. The project was selected the winner of 2024 IGGA award in the “Benefitting Society” category [16], the first runner-up of the 2024 SUN (Sustainable University Network) Thailand award, and a prize from 2024 Asian Sustainable Campus Network (ASCN) with the recognition as a waste management model that created a clean environment, improved health and well-being, and generated income from waste disposal.

3.2. The 3C Partnership for Sustainable Transportation

The United Nations General Assembly in 2023 endorsed the first-ever United Nations Decade of Sustainable Transport (2026-2030) to emphasize that sustainable transport — with its objectives of universal access, enhanced safety, reduced environmental and climate impact, improved resilience, and greater efficiency — is central to sustainable development [17]. Since higher education institutions are large, complex organizations with hundreds or thousands of daily commuters, transportation is an important part of their large carbon footprints, which will bring great concern for environmental impact [20]. With this recognition, Siam University includes environmental sustainability relating to sustainable transportation within our core organizational policy and program commitments. The policies of "Sustainable University, Sustainable District" and the "Siam University Carbon Neutrality 2045" were implemented. Therefore, besides community development projects for a sustainable district mentioned earlier, we also initiated projects for sustainable transportation on the campus, in the community, and in the district. Within our campus, we provide a zoning area for the vehicles powered by internal combustion engines, encourage carpooling and limit the number of vehicles on the campus, and campaign active modes of transportation by encouraging the use of zero-emission vehicles such as electric cars and bicycles. In the district, the "Green Travel", "Green bicycle route", and other related projects were also initiated around communities in the Phasi Charoen district. Examples of our recent work for sustainable transportation in the community and district are as follows.

3.2.1. Case 1: S-Guard Barrier Poles for Safe Pathway

According to statistics from "Traffy Fondue", an application of the Bangkok Metropolitan Administration (BMA), there were 543 complaints during May 2022 – July 2023 with regard to safety on pathways. The highest complaints (182 cases, or 33.52% of total complaints), of which the pedestrians reported that motorcycles often drove on the pathways to avoid traffic, were from 8 areas, including the main road in front of Siam University. The Phasi Charoen District Office has tried many measures, including the installation of poles, but they were not user-friendly, especially for those with wheelchairs. Siam University was then asked to solve the problem. After discussing with the community members who use the pathways, the solution is the S-Guard Barrier Poles, which allow wheelchairs to pass through but prohibit motorcycles. After installing the S-Guard Barrier Poles on pathways of the 8 most-compliant areas, "Traffy Fondue" reported that the number of complaints reduced drastically to only 8 cases. At present, the office has installed S-Guard Barrier Poles in 15 areas. The BMA is also satisfied with the results and has set a policy to start this project in other districts in Bangkok.

3.2.2. Case 2: Smart Garbage Collecting Motorcycle

This innovative project of using electric motorcycles to transport garbage in narrow alleys in the Phasi Charoen area was undertaken by the Faculty of Engineering. Many communities in the district have a problem of waste management in narrow alleys where transport trucks cannot enter to collect waste in the area, resulting in waste pollution, which affects the quality of life of people in the community. As such, a method to manage and transport this waste that will not cause waste pollution problems is required. The Phasi Charoen District Office and Siam University have given importance to solving this problem in the communities. Department of Civil, Environmental and Sustainable Engineering, Siam University, then designed an innovative motorcycle trailer for transporting garbage in narrow

alleys based on a concept of energy saving and clean energy use, especially electric and solar energy, which creates sustainability in energy conservation. The design process is to develop an electric motorcycle that can be charged directly from solar cells.

Figure 2. S-Guard barrier poles in front of Siam University
Source: Phasi Charoen District Office

The initial project involves installing solar panels on the garbage truck and studying its usability. This is to meet the needs to access the narrow alleys in communities for garbage collection and transportation, to reduce the problem of garbage accumulation, leading to garbage pollution. Methods and procedures of the projects are as follows, study the problem of waste management in the Phasi Charoen community area, meeting with community cleaning officers in Phasi Charoen District to jointly design solutions to the problem of garbage collection in narrow alleys, design a prototype of an electric motorcycle trailer to transport both organic and inorganic waste in narrow alleys in community areas, testing of electric motorcycles with garbage trailers in community areas, Phasi Charoen District, to improve and modify the efficiency of electric motorcycle to be more efficient, improve electric motorcycles according to community suggestions for better efficiency, and develop a plan to install slar panels so that charging electric motorcycles will be possible, and participate in testing electric motorcycles that can be charged directly with solar energy in community areas, along with summarizing the results and suggestions for the projects.

In the testing phase, an electric motorcycle with a trailer was used to collect and transport waste in a sample community in the Phasi Charoen area. Lad Pachi community volunteered to be one of the pilot areas to use the “Smart Garbage Collecting Motorcycle” prototype as seen in Figure 3, since they have started the zero-waste management project with the support of the Phasi Charoen District Office. The community has been campaigning to separate organic from inorganic waste for some time. However, there are still pain points even though community members are willing to participate. Lad Pachi is a small community and has many small alleys that prohibit large garbage collecting trucks from getting through.

The “Smart Garbage Collecting Motorcycle” clearly helps solve this aching problem. It was found that this prototype was able to transport waste in narrow alleys very well without causing pollution and saving fuel energy. The community leader and members reported that they are satisfied with the prototype and gave many suggestions that are beneficial to develop the innovative garbage collecting motorcycle in the second phase. For instance, there are suggestions that a charging station with solar panels and necessary measuring devices, such as dust meters, CCTV cameras, should be installed in the community to make it more efficient. In summary, the testing of a prototype of the electric motorcycle with a garbage trailer that can charge directly from solar cells is an innovation that facilitates garbage collection in the narrow alleys. The results of this test will be used to further develop and scale up for industrial use.

Figure 3. Smart garbage collecting motorcycle prototype and experiment in community
Source: Siam University

4. Conclusions

This paper highlights the critical role of Campus–City–Community (3C) partnerships in advancing not only the United Nations Sustainable Development Goal (SDG) 17—Partnerships for the Goals—but also in contributing significantly to SDG 11, which focuses on sustainable cities and communities. Recognizing the growing complexity of sustainability challenges, Siam University developed the 4Co Action Model as a strategic framework to guide structured, inclusive, and goal-oriented collaboration among diverse stakeholders in pursuit of the SDGs. Drawing on illustrative case studies, this paper demonstrates the practical applicability and scalability of the 4Co Action Model in establishing and sustaining effective multi-stakeholder partnerships. The model emphasizes four iterative and interconnected processes—Co-create, Co-design, Co-produce, and Co-reflect—that collectively support meaningful stakeholder engagement, mutual learning, and transformative change.

The 3C partnership employing the 4Co Action Model has proven to be an effective approach to strengthening a sustainable district. However, several key lessons emerged from

the implementation of this model. First, while partners may bring diverse backgrounds, experiences, knowledge, attitudes, and skills to the collaboration, a shared commitment to addressing common challenges is essential. Second, the principle of shared ownership is crucial across all stages of the collaboration, ensuring that all voices are heard and responsibilities are equitably distributed. Third, the success of 3C partnerships depends on continuous monitoring, reflexivity, and adaptive management, allowing partners to navigate complexity and respond constructively to challenges. When collaborative efforts are struggling, pursuing incremental "small wins" can serve to consolidate trust and build a foundation for more ambitious joint initiatives [18]. Fourth, in some contexts, formal agreements may be necessary to support the co-production of sustainable solutions among 3C partners. Finally, the outcomes of these partnerships extend beyond tangible products or problem-solving. They also foster essential competencies among all participants. This aligns with the enduring philosophy of the late King Rama IX of Thailand—"Give people a fishing rod, not the fish"—which emphasizes the importance of empowering individuals and communities to become self-reliant as the most sustainable path to long-term development [19].

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Authors Contribution

C.R. initiated the 4Co Action model, which is the main methodology of the case studies, oversaw the projects, led the analysis, writing, and revision of the manuscript. **P.M.** initiated, conceptualized, and supported R&D of the S-Guard Barrier Poles for Safe Pathway and Smart Garbage Collecting Motorcycle, while **T.K**. led the R&D and supervision of the two projects. **N.A.** carried out the "Tiny Heroes, Global Saviors" project by collecting data, experimenting, and overseeing the project progress of the protein-based pet food in **L.P.** community, while **J.R.** initiated and conceptualized the research idea.

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