

Solid Wastes Management of Monastery by Circular Economy: Case Studies of Chakdang and Suankeaw Temples in Thailand

Pitsanu Pannaracha¹, Mayuree Teyarajkul², Torpong Kreetachat³, Wanpen Wirojanagud^{4*}

¹ Faculty of Public Health,
Burapha University, Saensuk, Mueang District, Chonburi Province 20131, THAILAND

² College of State Administration, Rajamangala
University of Technology Phra Nakhon, Dusit, Bangkok, 10300. THAILAND

³ School of Energy and Environment at the University of Phayao,
Muang Phayao, Phayao, 56000. THAILAND

⁴ Environmental Engineering Association of Thailand,
122/4 Soi Rewadee, Rama VI Road, Samsen Nai, Phaya Thai, Bangkok, 10400. THAILAND

*Corresponding Author: wanpen@kku.ac.th

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Abstract

Along with the natural uses for production and consumption; various waste types, particularly solid wastes have been massively increased. Municipal solid waste is one of the critical generating solid wastes. Monastery, as one type of municipal solid wastes generating sources, has been rarely justified for solid waste management. This paper is to present solid wastes management of the Monastery using circular economy (CE) concept. The study monasteries included Chakdang and Suankeaw Temples in Thailand. Both temples have carried out solid wastes management on CE approach, 5 Rs (Reduction, Repair, Recycle, Reuse, Refurbish), but different in some Rs implementation. Chakdang Temple has emphasized recycle processing particularly plastic bottles recycled to fibres to proceed for yellow robe for monk, blanket, T-shirt, etc; biodegradation of food wastes to fertilizer by digestion tank, composting of plant residue to fertilizer, conversion of plastic bags and plastic straws to gasoline by pyrolysis. The CE approaches were mainly reduction through separation together with recycle, and some repair and refurbish. While Suankeaw Temple has used the donated items (mostly electric items and furniture including televisions, refrigerators, fans, computers, beds, wardrobes, chairs, tables, etc) for solid wastes processing through separation and selling to the old goods retailing shops by auction; bio-degradation of animal excreta wastes to earthworm-fertilizer as well as bio-degradation of food wastes, agricultural residue mixed with human excreta and animal manure to fertilizer. The approach was mainly reduction together with repair, and some refurbish. The outcome of the Circular Economy approach in terms of value addition on recycle and repair solid wastes were approximately 0.3 Million US\$ a year for Chak Dang Temple, and 15 Million US\$ a year for Suan Kaew Temple. For both monasteries has been attained Sustainable Development Goal. The research also studied for the factors influencing towards Resulted Base Management. Leader and

leadership of the abbots of both temples are the main factors influencing the people to cooperate for solid wastes management by CE approach.

1. Introduction

Solid wastes have been realized as the worldwide problem due to an enormous amount of solid wastes generation yearly by the improper development of community, industry, and agriculture. Natural resources have extremely been exploited to produce various goods and products to accomplish the population needs. Along with such natural uses for production; various waste types, particularly solid wastes have been critically increased. A 2012 World Bank report, estimating that municipal waste generation would be double over the next 20 years in the low-income countries. On top of that, manufacturing processes are often themselves inefficiency, leading to further deterioration of natural resources [1],[2]. Considering the recyclable wastes, in 2019 the generation of municipal solid wastes of 194 countries was more than 2.1 thousand million tons but the recyclable wastes was proximately 323 million tons or approximately 16% of the generated municipal solid wastes. About 960 million tons of municipal solid wastes or 46% of the generated municipal solid wastes had unsanitary disposed of to the landfill [3]. Based on the social prospect, the communities locate in the unhygienic condition covered with solid wastes where is the place for an epidemic of diseases, poor scenery, poor quality of life, etc [4].

For Thailand, in 2017-2022 the solid wastes had been generated in the range of 24.98-28.71 million tons per year, of which the generation rate was 1.03-1.18 kg per capita per day [5]. Critically, the adverse solid wastes problem is plastic wastes, being generated more than 2.0 million tons per year recorded in the past 10 years. The Government Policy has announced Solid Wastes as the National Agenda (August 26, 2014) with the Action Plan on "Thailand Solid Wastes Free" under the Master Plan of National Solid Wastes Management (2016-2021) for driving Thailand to be Zero Wastes Society on the concept of 3 Rs (Reduction, Reuse, Recycle), which is the preliminary concept of circular economy [6,7,8].

By and large, today's manufacturing takes raw materials from the natural resources (being the main component of environment), and turns them into new products, which are then disposed into the environment after use. It is a linear process with a beginning and an end. The circular economy, as the alternative of linear economy, is a new way of creating value, and ultimately prosperity. It works by extending product lifespan through improved design and servicing, and relocating wastes from the end of the supply chain to the beginning; which means that using resources more efficiently by using them over and over, not only once [9]. In other word, it practically implies reducing wastes to a minimum [10]. Remarking that, not only technical approach but also social approach as fir participation toward circular economy would enhance sustainable waste reduction [11].

Based on the Thirteen National Economic and Social Development Plan and Action Plan on Bio-Circular-Green (BCG) Model, it leads to the solid wastes management at the generating sources including houses, apartments, shops, markets, governments, temples [12],[13]. Solid wastes management, however, at temples has been rarely studied. Once in 2004, solid wastes generation in temple was studied. It indicated that solid wastes generated by monk, young monk, nun 0.5-0.8 kg per capita per day; monk's attendant 0.8-1.0 kg per capita per day, and people coming to temple for Buddhism activity 1.5-2.0 kg per capita per day [14]. Ones can estimate that how much solid wastes generated in the temples as there are 42,461 Buddhism temples, 205,513 monks and 239,023 monks during the Buddhist Lent recorded in 2020 [15]. Currently, there are some temples have carried out some noteworthy solid wastes management employing local wisdom of circular economy, which is very enticing to study for value addition on solid wastes management processing by circular economy. However, the solid wastes management using circular economy conducted in temples could be effective through the social perspective towards the Result Based Management. Factors influencing RBM include leader and leadership, motivation, participation, networking [16].

Accordingly, the principal study objective was to assess the value addition of solid waste processing using CE as well as the factors influencing the Results Based Management (RBM). Noting that this is the action research for introduction of circular economy to the monasteries considered as one of generating solid wastes sources which have not been realized to date.

2. Material and Method

This research was both quantitative and qualitative study. The quantitative study covered the CE process application for solid wastes management in the study temples. Qualitative study employed the depth interview with the ones who involve solid wastes management in the study temples. There were 2 study temples including Chakan Temple, Suan Kaew. Temple. The study process had mainly performed through investigation of the study temples during December 2023 to May 2024. The intensive inspecting for CE performing included types of solid wastes, CE processing and technology applied. The interviewee included abbots, abbot assistants, heads of the solid wastes management activities, workers, municipality representatives. private sector representatives, which were about 8-10 interviewee of each temple. The interview content related with the factors influencing RBM

including leader and leadership, motivation to perform CE, team work and networking, income generation, which are open-ended question. Notifying that this research is not depth for technological mechanism, it is a feasible application of CE to the temple which is one of ignoring sources of solid wastes generation. Thus, it can be recommended for other temples and communities.

3. Result and Discussion

For solid waste processing, both temple models have applied circular economy 5 Rs (reduction, repair, recycle, reuse, refurbish), but are different in some Rs implementation. The following results are presented and discussed.

Chakdang Temple solid wastes management was initiated by the authors who has studied by self-learning, and trial and error experiments with local wisdom towards sustainable concept. Solid wastes management has been firstly performed by separation to wet solid wastes, dry solid wastes and hazardous wastes. Fig. 1 presents the main component of solid wastes and recycle through CE processing of different solid waste types. Wet solid wastes are biodegradable organic wastes, which are collected from the communities located nearby the temple, convenient store (namely 7-11 mini-shop), banks, offices, as well as food wastes generated in temple. Biodegradable organic wastes are converted through anaerobic digestion (fermentation tank) to fertilizer.



Fig. 1 Solid wastes segregation and recycle at Chakdang Temple

In addition, composting of leaves and tree branches residue mixed with seed is undertaken to produce fertilizer. Wet solid wastes recycle to fertilizer is presented in Fig. 2. Remarking that the wet solid wastes fertilizer is the main recycle product generated a substantial income for the temple. Dry solid wastes particularly plastic bottles recycled to the polyester fiber mixed with cotton fiber and enameled with zinc nano for bactericidal function, then proceeded to the yellow robes for monks, blankets, T-shirts. etc. Perceiving that the temple only collects plastic bottles and make them flatting. Plastic fiber enameled with zinc nano produced from the flat bottles are carried out at the factories. Then the enameled fiber are sent back to the temple to sew the products as required. Other recycle process require more technological knowledge and modern equipment are conversion of plastic bags and other thin plastics to gasoline through pyrolysis.

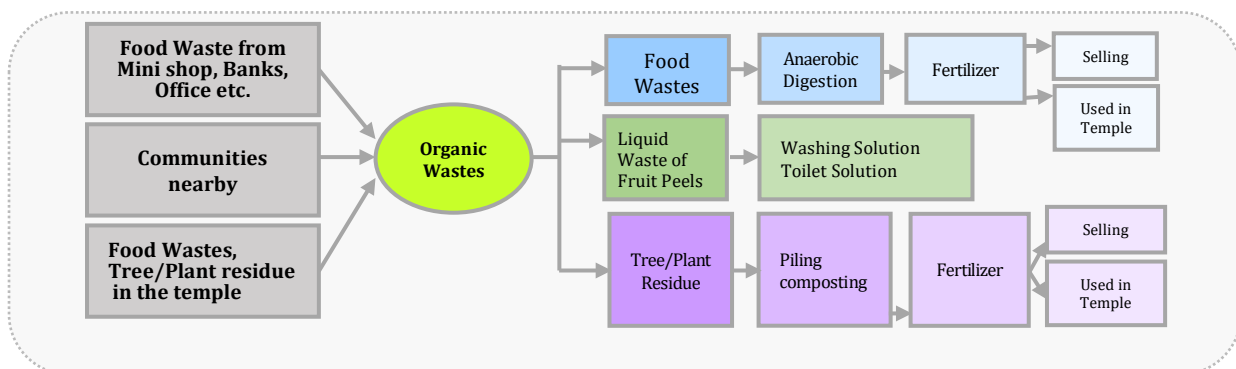


Fig. 2 Recycle of organic wastes

Regarding other recycle products include milk box for roof material, bottles caps for cloth hangers, foam mixing with concrete for brick block, very fine grass particles for Buddha amulet etc. Recycle dry solid wastes is presented in Fig. 3. Thus, Chakdang Temple has employed CE by mainly reduction through separation and recycle, as well as repair and refurbish for some donated furniture being used at the temple and donated to the communities as requested. For the income generation, in 2023 the income was approximately 7.0 million Baht (0.21 million US\$) compared to the expense was approximately 6.0 million Baht (0.18 million US\$). The income of Chakdang was about 1.0 million Baht (0.03 million US\$). Noting that it was only one year data (2023). Based on the conversation with the abbot, before 2023 the income was quite low because the products could not be sold much as the plastic fiber products were too expensive. The main income was for fertilizer selling. Moreover, in 2023 the abbot could establish networking with other business sectors (eg. PTT) as well as the Non-Government Organization such as the Chai Pattana Foundation. The temple project, thus, had financial support such as food waste fertilizer, pyrolysis of plastic bags to gasoline, as well as the marketing of fertilizer was better, generating more income. Noticeably, income of the recycled solid wastes was not high as this temple is small temple and solid wastes by CE was only initiated. If ones think about solid wastes reduction, particularly plastic wastes, as well as workers (low-income people) hiring, such CE performed at Chakdang Temple, thus, creates invaluable income.

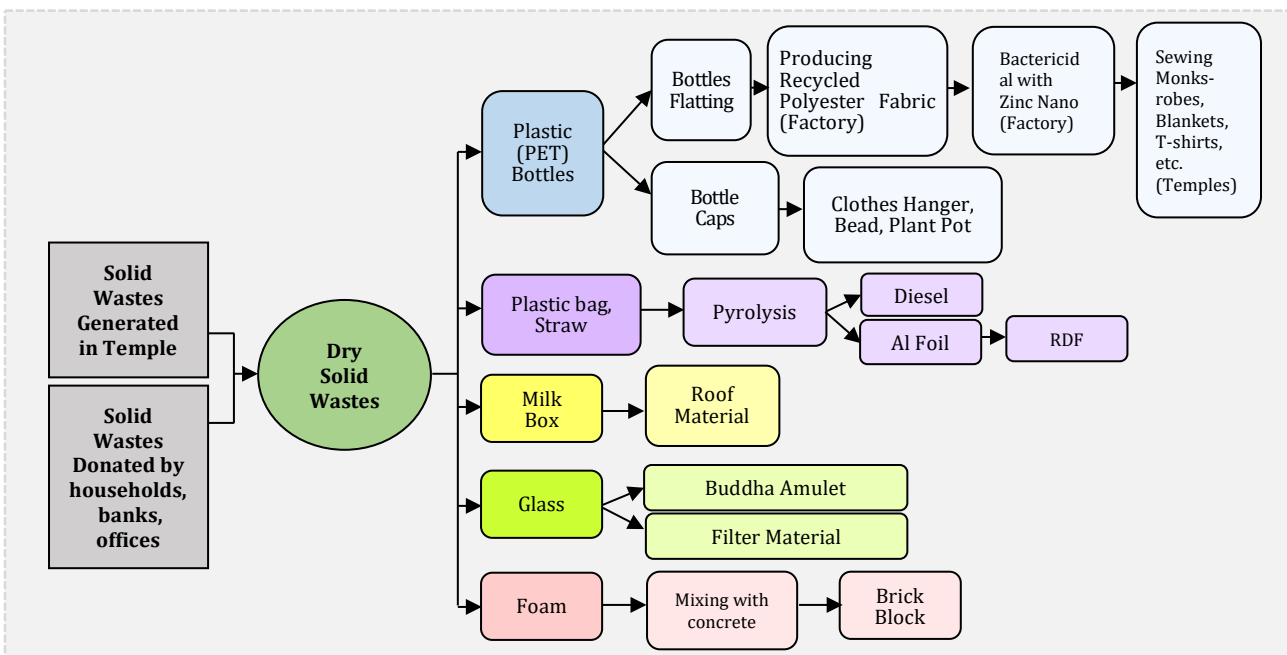


Fig. 3 Recycle of dry solid wastes at Chak Dang Temple

Suankeaw Temple uses the donated items (mostly electric items and furniture including television, refrigerator, fan, computer, bed, cupboard, chair, table, etc.) for CE processing. The donated items are separated and selling to the old thing retailing shops by auction. Food wastes were bio-degraded to fertilizer using earthworms, agriculture residue mixed with excreta of human and animals were bio-degraded to fertilizer by anaerobic digestion. Some CE processing is presented in Fig. 4 and Fig. 5 for wet and dry solid wastes, respectively. The CE approach at Suankaew Temple is mainly reduction with repair, and some recycle. In terms of income generation, the net income was about 50 million Baht a year (1.46 million US \$) for both selling of the repair donated items, the donated item auction and agriculture products. Comparing to Chakdaeng temple, Suankaew Temple has made more income than Chakdang temple as the temple has both solid wastes separation plant selling the donated solid wastes items by auction and a huge horticulture area. Income is thus from both solid wastes management and horticulture. Moreover, Suan Kaew temple has helped hiring the unemployed workers as well as low-income people. This invaluable outcome, not only for solid wastes reduction but also for the job earning.

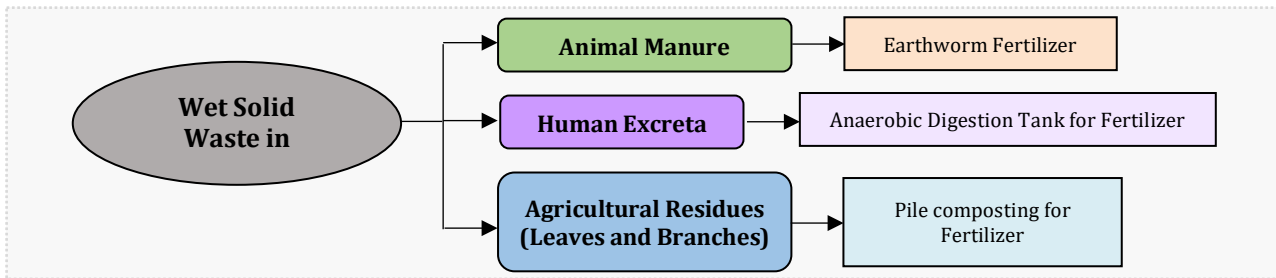


Fig. 4 Recycle of organic wastes at Suan Keaw Temple (Agricultural waste in horticulture area)

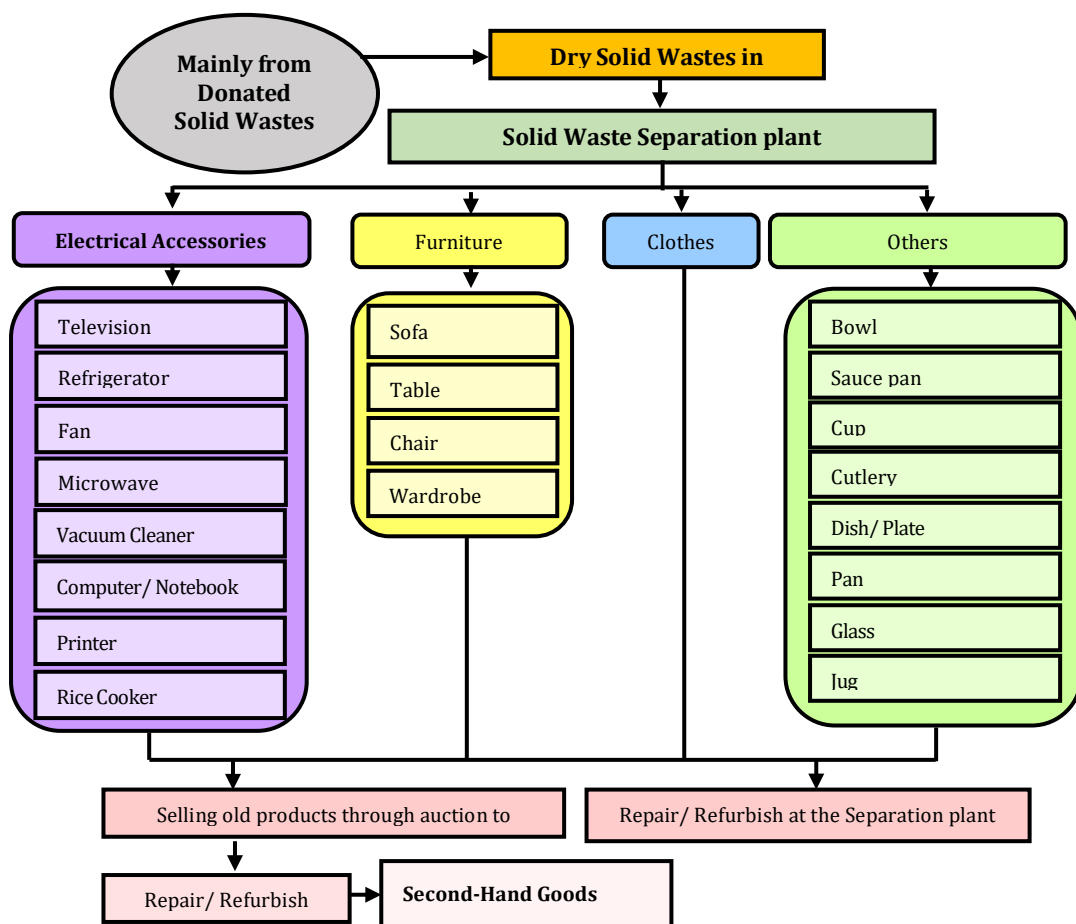


Fig. 5 Solid wastes segregation, repair and refurbish at Suan Kaew Temple

As the qualitative research, the factors influencing RBM had been studied by depth interview with the stakeholders relevant to CE on solid wastes management (being the mentioned interviewee) through the ended open questions as mentioned above. In accordance with the interviewing results, the influencing factors are identified and presented in terms of qualitative output. Among the study factors, the significantly major factor was leader and leadership of the abbots. Such leader and leadership had encouraged motivation of people and private sector including bank, grocery stores, banks, and governmental sector (municipalities) to cooperate with the spiritual wellness community and solid wastes processing by CE. In addition, innovation of integration of Buddhism principle and solid wastes processing through circular economy particularly reduction and repair (Suankaew Temple) and reduction and recycle (Chakdang Temple), cooperation due to motivation created by the leader and leadership of the abbot, networking induced by personnel and/or organization cooperation and foundation branching, and policy to action indicated by the evident outcome were all factors influencing the RBM.

Nevertheless, the sustainability of the work should be considered in terms of the human resource development to accommodate the current and future work, as well as the data base of the income and expense should be systemic developed for evaluation and monitoring of the solid wastes management by CE.

4. Conclusion

Value addition on solid wastes management of the monastery using circular economy was researched quantitatively and qualitatively. There were 2 study temples including Chakdang Temple, Suankeaw Temple. The quantitative study included application of CE process for solid wastes management in the study temples. Qualitative study using depth interview with the abbots, abbot assistants, monks, workers, private sector representative (ie. the secondhand shop owner), municipality's representative in the study temples. Both temples had carried out solid wastes processing by CEs, 5 Rs (reduction, repair, recycle, reuse, refurbish), but are different in some Rs implementation. Chakdang Temple had emphasized the recycle processing particularly plastic bottles recycled to fiber to proceed for yellow robe for monk, blanket, T-shirt etc; biodegradation of food wastes to fertilizer by fermentation tank, composting of plant residue to fertilizer, conversion of plastic bags, plastic straws to gasoline by pyrolysis. The CE approaches were mainly reduction together with recycle, and some repair and refurbish. While Suankeaw temple has used donated items (mostly electric items and furniture including television, refrigerator, fan, computers, beds, wardrobes, chairs, tables, etc) for solid wastes processing through separation and selling to the old thing retailing shops by auction, bio-degradation of food wastes to earthworm-fertilizer as well as bio-degradation of agricultural residue mixed with human and animal excreta to fertilizer. The approach was mainly reduction together with repair, and some recycle. The significant factors influencing the RBM was leader and leadership of the abbot. Such leader and leadership had enticed the people motivation towards cooperation with the integration of spiritual wellness community and solid wastes processing by CE. In addition to the leader and leadership, integration management, innovation of solid wastes processing by CE, cooperation, networking, and policy/plan to action were all factors influencing the RBM on the sustainable development concept; balancing on economic, social, and environmental aspects. Noting that this paper is introduction of CE to manage solid wastes generating in the monastery, considered as the community solid wastes source being ignored for management. It can be elaborated more in-depth research technology and put it to action through RBM.

5. Recommendations

- Conducting an intensive of solid wastes management using CE focusing more on quantitative analysis through cooperation with the academic institutes.
- Developing the CE model for solid wastes management for the monastery and communities through Local Authority Organizations.

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Conflict of Interest

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

Author Contribution

The authors are responsible for the study conception, research design, data collection, data analysis, result interpretation and manuscript drafting.

References

- [1] Hoornweg, D. & Bhada-Tata, P. (2012). *WHAT A WASTE: A Global Review of Solid Waste Management*. Urban development series; knowledge papers no. 15. World Bank. Washington, DC. <http://hdl.handle.net/10986/17388>
- [2] Hussien Hegab, Ibrahim Shaban, Muhammad Jamil, Navneet Khanna. (2023). Toward sustainable future: Strategies, indicators, and challenges for implementing sustainable production systems. *Sustainable Materials and Technologies*, Volume 36, July 2023, e00617. <https://doi.org/10.1016/j.susmat.2023.e00617>

- [3] Verisk Maplecroft. (2019). Waste Generation and Recycling Indices. (2019) Overview and Findings. https://www.circularonline.co.uk/wp-content/uploads/2019/07/Verisk_Maplecroft_Waste_Generation_Index_Overview_2019.pdf.
- [4] Giovanni Vinti, Valerie Bauza , Thomas Clasen , Kate Medlicott , Terry Tudor, Christian Zurbrügg, Mentore Vaccari. Municipal Solid Waste Management and Adverse Health Outcomes: A Systematic Review.
- [5] International Journal of Environ Research Public Health. 2021 Apr 19;18(8):4331. <https://doi.org/10.3390/ijerph18084331>
- [6] Pollution Control Department. (2023). Thailand State of Pollution Report 2022. Bangkok. AP Connex Co.,Ltd.
- [7] Department of Local Administration Promotion and Pollution Control Department. (2016). Pracharath Policy: Guidelines for waste management in Thailand. https://resolution.soc.go.th/PDF_UPLOAD/2559/9932126447.pdf.
- [8] Pollution Control Department. 2022. The 2nd National Action Plan on Waste Management in Thailand https://www.pcd.go.th/pcd_news/26688
- [9] United Nations Industrial Development Organization. (2017). Circular Economy. https://www.unido.org/sites/default/files/2017-07/Circular_Economy_UNIDO_0.pdf.
- [10] UNECE UN Environment Programme, Environment Agency Austria. (2022). Waste Management towards a More Circular Economy. https://unece.org/sites/default/files/2022-02/WASTE_EN.pdf
- [11] Ellen Macarthur Foundation Organization. (2019). The Circular Economy in Detail. <https://www.ellenmacarthurfoundation.org/the-circular-economy-in-detail-deep-dive>
- [12] Kiewchaoom, J., Keawma, J., Kiewchaoom, S., Thongkaw, S., Siripiban, S., Siriwong, S., Thongkaw, U., Inthanujit, K. & Khamhean, K. (2020). Sustainable Waste Reduction in Lipe Island by Participatory Process. Bangkok: National Research Council of Thailand (NRCT).
- [13] Office of National Economic and Social Development Council. (2023). The Thirteenth National Economic and Economic Social Development Plan (2023-2027). https://www.nesdc.go.th/article_attach/article_file_20230615134223.pdf
- [14] Srisatit, T. (2015). Municipal solid waste management engineering. Bangkok: The Engineering Institute of Thailand Under H.M. The King's Patronage. ISBN 978-974-7197-96-9.
- [15] Pollution Control Department. (2004). Work Manual: Using Solid Waste to Benefit Buddhist Temples. Bangkok: The Printing House of the Teachers' Council Ladprao. <https://www.pcd.go.th/publication/4754>.
- [16] National Statistical Office. (2020). *Statistics on Personnel and Religious Places in Thailand* [Data set]. http://ittdashboard.nso.go.th/preview.php?id_project=56.
- [17] Mayuree Teyarajkul.(2024) Wastes Management for Value Addition Based on the Circular Economy: Case study of Chak Dang Temple and and Suan Kaew Temple. PhD. Thesis. Department of State Administration, College of State Administration. Rajamangala University of Technology Phra Nakhon