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Municipal Solid Waste Management Development Model through Participatory Process based on Circular Economy in Highland Tourism Area

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Abstract

The goal of waste management in Pai District's highland areas is to learn from local initiatives for participatory rubbish management. In this study, the following questionnaires were used: (1) the questionnaire on prototype project satisfaction (public/private), (2) the questionnaire on prototype research project satisfaction (Entrepreneurs), (3) the questionnaire on overall project satisfaction, and (4) the questionnaire on the level of satisfaction with the project's promotion aspects. A 300-person purposive sample was used. The descriptive statistics used in the analytical data included percentages, means, and standard deviations. As a result, the level of satisfaction with the prototype research project was high for public/private and moderate for entrepreneurs. The assessment of satisfaction with the research extension project revealed a very high degree of satisfaction with both the overview project and the promoted project elements. Furthermore, this study tracks recycled garbage sales and the outcomes of waste separation operations for 18 months, indicating the success of operations in the Pai district. The proceeds from the sale of recycled garbage have been set aside for community purposes such as funeral expenses. It is a management strategy that can result in a more sustainable approach to Municipal Solid Waste Management.

Keywords : Circular economy; Municipal Solid Waste; Lesson learned

Introduction

Currently, tourism is being promoted in numerous nations throughout the world in several ways, which has caused the service industry that supports it to grow. It gives substantial financial support to landlords everywhere. The fastest-growing industries were the hotel industry, travel agencies, retail, restaurant, service, and exchange companies [1]. When there is tourism in the area or a gathering of people anywhere, especially at a well-known tourist destination, environmental pollution, especially trash pollution, always happens [2-3]. In tourist destinations with surrounding mountains of great height or in high-altitude regions, we frequently battle with the problem of managing solid trash due to tourism and a variety of community activities, which includes waste from homes, hotels, markets, shops, and other commercial facilities as well as from activities on roadside vendors [4]. Most of these wastes have negative immediate and long-term effects on both human life and the environment [5]. Additional activities have a big impact on the rise of specific waste types, too, according to visitor preferences [6].

Therefore, it is essential to assess the region's capacity for waste management. Particularly in urban areas where the tourism industry is quickly growing, which could link development in three key areas: economy,

social, and environment [7-8], and when utilizing a sustainable development-based system for environmental assessments. The importance of ecological issues has been found to be such that they can be taken into account in conjunction with land use and urban planning. In addition to other ways, we could link economic, social, and environmental concerns together [9]. The 11th National Economic and Social Development Plan of Thailand has a policy on transport networks that is intended to assist and go hand in hand with Pai's expansion, encouraging it to serve as the province of Mae Hong Son's hub for ecotourism.

Ministerial Regulations' contents The Royal Gazette reports that in 2015 and 2017, enhancements and alterations were made in order to promote tourism in Mae Hong Son Province. The ministerial regulations specify Royal Gazette advertise Mae Hong Son Province as a resource-efficient metropolis with a wealth of natural resources, promote an organic agriculture, ecotourism, develop a community economy, land utilization along riverbanks and allocate an area for waste disposal, including a hazardous substance disposal area complies with the Hazardous Substances Act. This is an area that may be affected by the tourism industry and rapid urbanization.

The responsible organizations' waste disposal methods are divided into 8 administrative areas, consisting of 1 municipality and administrative organizations in 7 sub-districts i.e., trench method without lining techniques, uncontrolled or open dump method and open burning method. Some of the crucial elements influencing waste management from tourism in the highlands are public collaboration, has the highest priority, followed by entrepreneur cooperation, which is more significant than economic and social aspects. In terms of the economy and society, it was discovered that the strength of the community has the highest priority, followed by economic growth, the number of waste buyers and prices, the number of tourists, tourist behavior, events or festivals, and the number of days stay overnight [9]. Tourist cooperation, waste segregation at source, recycling and reuse, and separation from operators are also important considerations [10-12]. The goal of this study was to draw conclusions on waste management practices in communities as a result of the application of research data to the prototype study project in Pai Walking Street, which looked at the effectiveness of garbage separation there. This study examined data utilizing surveys, questionnaires, and in-depth interviews on important factors that support effective community trash management. The study's findings can be examined to identify the advantages and disadvantages of waste management. It can be used to establish a clear policy that can lead to environmentally friendly activities in the region. The findings from this study can be beneficial to the planning and design of sustainable urban development based on the concept of livable cities to control the growth of tourism waste in the future.

Material and Methods

1. Study Area

Pai is a district in the province of Mae Hong Son. It is located in the coordinates 19°21′31″N 98°26′24″E. It is a small region with an area of 2,244.7 square kilometers that resembles a pan-basin surrounded by mountains or a valley city. Doi Mae Ya is the highest mountain peak in Thailand, rising 2,005 meters above sea level. It is located in Mae Hong Son Province's northeast, around 100 kilometers from Mueang Mae Hong Son district and 820 kilometers from Bangkok. Pai is a district in Thailand that borders Myanmar and consists of 66 villages under the jurisdiction of seven sub-districts and one municipality. It has a city area of 11.27 square kilometers and a municipal responsibility area of 2.4 square kilometers. Figure 1 depicts the research area. According to a summary of visitor conditions for the year 2018, Mae Hong Son saw 1,004,967 visitors, up 0.027 percent, and generated 4,980.71 million baht in revenue from tourism, up 2.40 percent [10].

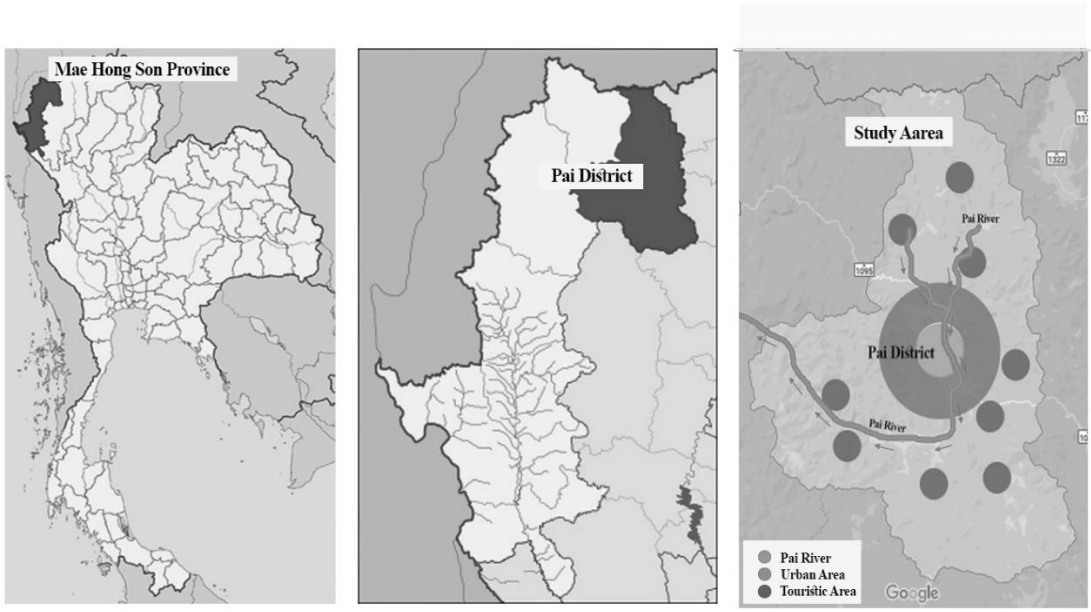

Figure 1 Study Area

2. Study Process

Based on Jessadanan's previous research [10, 12] used the environmental education approach to create a waste management prototype for Pai Municipality (Figure 2, left panel) and tested the prototype. Throughout 18 months, we expanded that prototype into a participatory solid waste management process (Figure 2, right panel).

1) Prototype Model to investigate the effectiveness of garbage separation in pedestrian-friendly streets Implement the project using an analytical procedure and following the research methodology, creating patterns and functional systems that fall under the purview of the work. Statistical analysis and the study of crucial components using the Analytic Hierarchy Process are both crucial tools for research evaluation. Analyses of urban planning and the volume and type of waste using accepted techniques. A survey of public opinion was used to assess the prototype research project's findings.

2) Model Implementation continuing research projects by collaborating with community organizations, for instance, by establishing a community waste management project as a sub-project under the Clean Homes, Pleasant Communities, Good Environment, Happy Lives project and adapting the activities to the local context until it can be developed into a community waste management project using funds under the name of the cremation fund to help communities. Figure 2 depicts the conceptual framework of the activities.

3. Method

1) This research used purposive sampling from the communities of 1 municipality and 7 sub-districts in the Pai district area by selecting from the citizen leaders who work on the waste separation project in Pai District 300 people. We studied the amount of waste data that has been sorted over 18 months. In addition, statistics on the sale of various types of waste that were extracted throughout the study period were displayed for comparison.

2) Using questionnaires to (1) Evaluation of satisfaction of prototype projects in research (public/private), (2) Evaluation of satisfaction of the prototype research project (Entrepreneurs), (3) the results of the study of the characteristics of the research extension project, (4) the assessment of satisfaction with the research extension project.

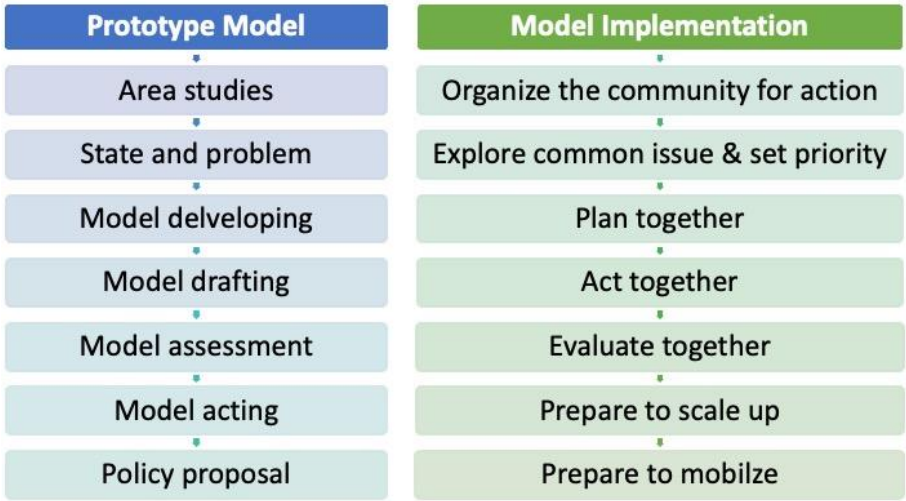

Figure 2 Conceptual Framework

3.1 Research tools

A total of 4 satisfaction questionnaires include: (1) The questionnaire on satisfaction of prototype projects (public/private), (2) the questionnaire on satisfaction of the prototype research project (Entrepreneurs), (3) the questionnaire on overall project satisfaction, and (4) the questionnaire on the project's promotion aspects' level of satisfaction.

3.2 Verification of the quality of the tools

To verify the quality of all questionnaires, the researcher verified content validity and the appropriate use of language with the help of 5 experts, the item-objective congruence or IOC = 0.85 and reliability level = 0.92.

Results and Discussion

In this study, we divided recycled waste into 10 categories: (1) PET plastic, (2) PP plastic, (3) colored PET plastic, (4) clear glass, (5) green glass, (6) brown glass, (7) colored paper, (8) cartons, (9) aluminum, and (10) metal.

1. Proportion of recycled waste of the prototype research project

According to the study, green glass makes up the largest percentage of recycled waste, or about 27% of all recycled waste, and is the most abundant type of recycled waste. The next two greatest kinds, brown and clear glass, account for roughly 26% and 18% of total recycled waste, respectively. The lowest category of recycled waste is colored PET plastic waste, which accounts for about 1% of your overall recycled waste (Figure 3).

2. Income from the recycled waste of the prototype research project

The study in Figure 4 shows that aluminum is the product that is most overall profitable because it makes the greatest money from recycled waste—roughly 1,410 baht. The next three categories are a PET plastic, which is worth approximately 1,046.8 baths, green glass, and brown glass, which are each worth approximately 655.47 baths and 642.06 baht. The whole earnings from recycled waste is just about 105.4 baht, with metal being the least profitable product.

3. The assessment of satisfaction with the prototype research project

3.1 Evaluation of satisfaction of prototype projects in research (public/private)

The project satisfaction assessment form's average scores, according to the study's Table 1, showed a high level of satisfaction. The average score of overall community benefits was 4.47 which was among the top 4 satisfaction assessment items with the highest average scores. The advantages to tourism's reputation were 4.40, and the suitability of the application in conjunction with other initiatives and the project's overall success were 4.33 respectively.

3.2 Evaluation of the satisfaction of the prototype research project (Entrepreneurs)

According to the survey, there was a moderate level of satisfaction with the average scores on the project satisfaction assessment form. As shown in Table 2, the first 4 satisfaction assessment criteria with the highest average scores were the appropriateness of the operational period (90 days) at 3.62, overall benefits to the community at 3.56, the appropriateness of the recyclable waste collection station and the appropriate working frequency at 3.46 respectively.

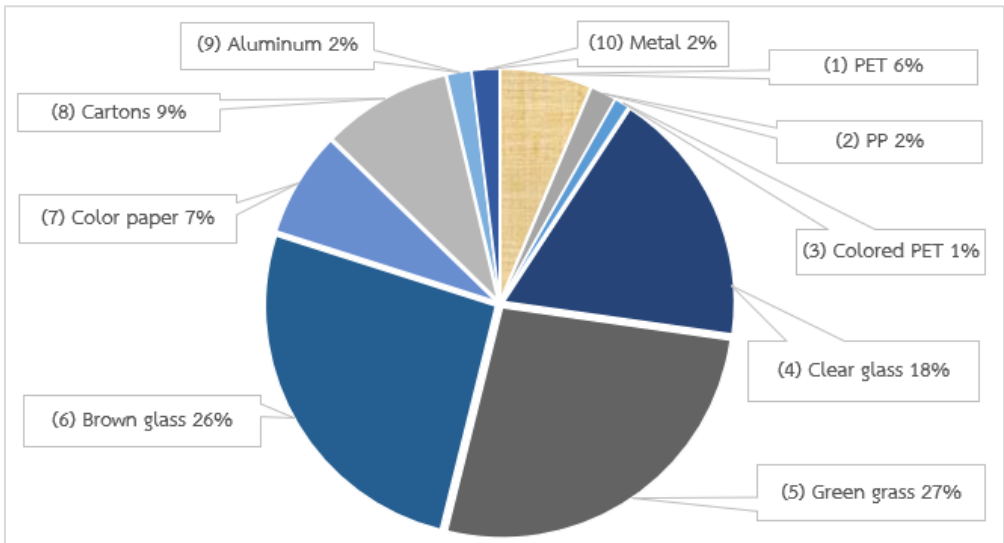

Figure 3 The proportion of recycled waste of the prototype project (%)

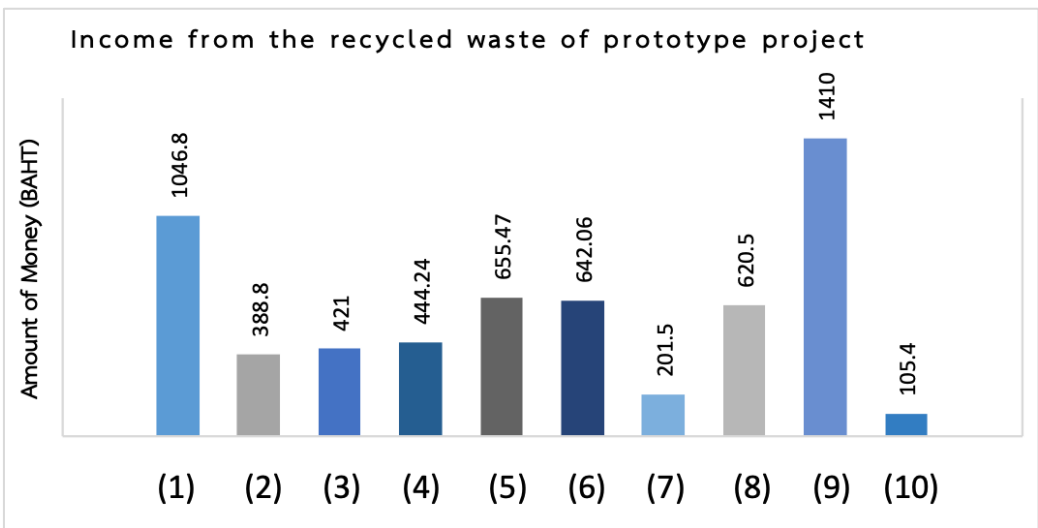

Figure 4 The income from the recycled waste of the prototype project (Bath)

Table 1 Evaluation of satisfaction of prototype projects (public/private)

Satisfaction assessment issues	$\bar{x}$	S.D.	Satisfaction level
1. Appropriateness of the operational period (90 days)	4.07	0.96	High
2. Appropriateness of complexity in the work system	3.93	1.03	High
3. Appropriateness of the project to the nature of the area / topography	4.27	0.80	High
4. Appropriateness of the project for public/private work	4.07	0.70	High
5. Management suitability and waste management from tourism	4.13	0.83	High
6. Appropriateness of recyclable waste collection station	4.00	0.85	High
7. Appropriate number of recycling collection station	3.87	0.99	High
8. Appropriateness of food waste collection station	3.73	0.96	High
9. Appropriate number of food waste collection station	3.87	0.99	High
10. Appropriate working frequency and number of operators	4.07	0.88	High
11. Overall Benefits to the community	4.47	0.64	High
12. Beneficial to the image of tourism	4.40	0.83	High
13. Appropriateness as a model for waste management from tourism	4.07	0.80	High
14. Appropriateness of application in conjunction with other projects	4.33	0.82	High
15. Overall project success	4.33	0.49	High

Table 2 Evaluation of the satisfaction of the prototype research project (Entrepreneurs)

Satisfaction assessment issues	$\bar{x}$	S.D.	Satisfaction level
1. Appropriateness of the operational period (90 days)	3.62	0.96	High
2. Appropriateness of complexity in the work system	3.38	0.85	Medium
3. Appropriateness of the project to the nature of the area / topography	3.44	0.85	Medium
4. Appropriateness of the project for public/private work	3.26	0.97	Medium
5. Management suitability and waste management from tourism	3.26	0.88	Medium
6. Appropriateness of recyclable waste collection station	3.46	0.91	Medium
7. Appropriate number of recycling collection station	3.44	0.75	Medium
8. Appropriateness of food waste collection station	3.33	0.81	Medium
9. Appropriate number of food waste collection station	3.26	0.85	Medium
10. Appropriate working frequency and number of operators	3.46	0.72	Medium
11. Overall Benefits to the community	3.56	0.68	High
12. Beneficial to the image of tourism	3.38	0.81	Medium
13. Appropriateness as a model for waste management from tourism	3.41	0.91	Medium
14. Appropriateness of application in conjunction with other projects	3.33	0.98	Medium
15. Overall project success	3.23	1.04	Medium

3.3 The results of the study of the characteristics of the research extension project

The amount of waste in January 2021 was 12,096 kg, the highest amount of waste during the research period and the income from selling waste was only 6,850 baht, which is a moderate amount compared to the amount of income over the course of the entire 18-month survey period. On the other hand, there were only 3,425 kg of waste quantity in January 2022 which decreased 8,671 kg compared with January 2021. But it has revenue from the sale of waste was 7,169 baht, which increase of 294 baht compared to revenue from the sale of waste in January 2021. According to Figure 5, May 2022 will bring in the highest income from recycled waste during the research period (7,170 baths).

4. The assessment of satisfaction with the research extension project

4.1 Summary review of the project

At a very high level of satisfaction, the average score for the satisfaction analysis criteria was 4.67. According to Table 3, the satisfaction assessment question with the highest average score was item 6: beneficial for the community (4.83 points), followed by item 3: appropriate place/purchase point of recyclable waste same as item 8: project success (4.67 points), and item 1: activity duration (4.58 points).

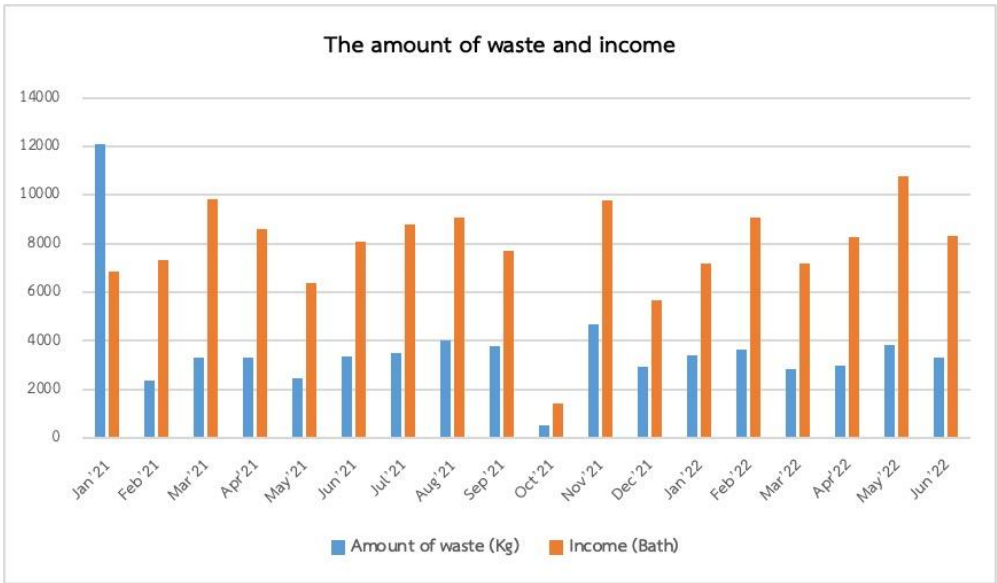

Figure 5 The amount of waste and income in January 2021 – June 2022

Table 3 Analyzing the overall level of project satisfaction

Satisfaction evaluation issues	$\bar{x}$	S.D.	Satisfaction level
1. Duration of activity	4.58	0.49	Very High
2. The complexity of the system	3.92	0.76	High
3. Appropriate place/purchase point of recyclable waste	4.67	0.47	Very High
4. Enough worker	4.08	0.95	High
5. Working frequency	4.50	0.50	Very High
6. Beneficial for the community	4.83	0.55	Very High
7. Applying with other projects	4.50	0.50	Very High
8. Project success	4.67	0.47	Very High

4.2 The project's promotion aspects' level of satisfaction

The satisfaction analysis criterion had an average score of 4.19 a very high level of satisfaction. According to Table 4, Item 16: the growth of community strength had the highest average score on the satisfaction rating scale (4.75 points), followed by item 2: employees providing care or advice (4.67 points). Whereas item 1: received promotion/support from executives, item 4: officers provide additional knowledge, and item 9: places and collection points are convenient and easy to access had the same average score (4.58 points).

Table 4 The project's promotion aspects' level of satisfaction

Satisfaction of factors that promote project success	$\bar{x}$	S.D.	Satisfaction level
1. Received promotion/support from executives	4.58	0.49	Very High
2. There is a staff to look after / give advice / advice	4.67	0.47	Very High
3. Get cooperation from other groups / or organizations	4.00	0.58	High
4. Officers provide additional knowledge	4.58	0.49	Very High
5. People gain more knowledge from activities	4.33	0.62	High
6. Get promoted/supported by community leaders	4.50	0.64	High
7. There is a budget for activities	3.33	1.18	Medium
8. Adequate materials and equipment	3.83	0.90	High
9. Places and collection points are convenient and easy to access	4.58	0.49	Very High
10. There is a policy of government agencies to support	3.58	1.26	High
11. There are ordinances. promote/support water	3.92	1.26	High
12. There is an ongoing campaign and public relations	4.50	0.50	Very High
13. Get cooperation from the public	4.17	0.90	High
14. Get cooperation from entrepreneurs / shops / others	3.25	0.92	Medium
15. There is a clear separation of household waste	4.58	0.64	Very High
16. The development of community strength	4.75	0.43	Very High
17. There is an economic stimulus in the community	4.25	0.60	High
18. There is an increase in the number of buyers who buy garbage and the price of garbage	3.58	0.95	High
19. Various traditional festivals / seasons have a positive effect on activities	4.42	0.49	High
20. Number of other activities in the area have a positive effect on activities	4.33	0.62	High

The Municipal Solid Waste Management Establishment Model through the Participatory Approach Based on the Circular Economy in the Highland Tourism Area is a study of the establishment of a systematic waste management approach. The revenues from the sale of recycled rubbish can be used to fund community projects. This research result is consistent with the case study in Lae City, the second largest city in Papua New Guinea and is rich in natural resources. The city's expansion led the human population to move. The rise in population caused by industrial expansion has increased municipal solid garbage. As a result, economic, social, and geographic aspects must be investigated. To develop potential approaches to trash management that are both efficient and sustainable. It is possible to launch a zero-waste resource recovery campaign that effectively engages stakeholders [14].

The community participation process yields outstanding benefits. Increasing engagement, education, and individual knowledge. The governmental and commercial sectors must provide adequate facilities and equipment, as well as undertake systematic recycling programs. It is crucial in solid waste management. With a greater emphasis on education, particularly through municipalities, and by developing involvement and promotion programs between families and municipalities. It is thus possible to enhance citizens' practices

by increasing their knowledge. Simultaneously, effective initiatives are done to encourage environmental activities. As in the study on the same subject in Kermanshah, Iran [15-16].

Conclusions

Northern Thailand's picturesque mountain resort of Pai is widely recognized for its stunning natural settings. The Mae Hong Son Loop is a popular tourist destination despite being a popular backpacker location. With a 27% recycling waste proportion, green glass, which is mostly made from alcoholic beverages but is not a valued recyclable waste, is the most common recyclable waste in the community. The most valuable recyclable waste is aluminum, a low-volume municipal waste that makes up 2% of total beverage package waste that can be recycled. This research supports the principles of the circular economy. In a circular economy, resources are used less, materials, goods, and services are redesigned to be less resource-intensive, and "waste" is recovered and repurposed to create new goods and materials [13].

The highest average scores are overall benefits to the community, which are used to measure the success and happiness of prototype projects for the public or private sector. For business owners, a moderate level of satisfaction by the highest average score indicates that the operational time (90 days) is adequate. According to data from the research project, the biggest amount of waste was generated in January 2021, and the highest amount of money was earned from recycled waste in May 2022.

There is a very high level of satisfaction with the research extension project according to the project overview's assessment, with the benefits to the community receiving the highest scores.

Recommendation

The research period was during COVID-19. There was a critical situation in the survey area affected by the amount of municipal solid waste in January 2021 than usual and the amount of waste will gradually return to normal at the time of the research. We recommend that you re-collect the research data once the research area returns to normal for more accuracy.

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