



Research Article

Social Return on Investment (SROI) from the Community Waste Bank Implementation under the Learning Center of Systematic Waste Management Innovation According to the Circular Economy Concept

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Abstract

This article presents the results of social return on investment (SROI) evaluation in the community's waste bank program implemented in the Moo 7 and Moo 8 Villages of Tan Diao Subdistrict, Kaeng Khoi District, Saraburi Province during 2020–2022, which is a part of the Learning Centre of Systematic Waste Management Innovation According to the Concept of Circular Economy project. This research employed participatory action research to collect data on total cost for investment and income from selling recyclable waste through in-depth interviews and focus groups with a total of 40 stakeholders including: 25 community members, 5 community leaders, 3 representatives from Tan Diao Subdistrict Administrative Organization, 5 village health volunteers, and 2 private waste buyers. The SROI analysis of the Moo 7 and Moo 8 waste banks (2020–2022) by using the discount rate based on the government bond yield at 3% shows the total net present value at 106,166.60 Thai Baht (2,941.76 USD), a ratio of cost-benefit analysis at 12.74 times, the payback period at 4.7 months, and the SROI result is 2.65 Thai Baht (0.073 USD). In other words, for every 1 Thai Baht invested in the community waste banks during this period, the benefits generated were equivalent to 2.65 Thai Baht (0.073 USD). This translates to a positive return on investment. The contribution of community waste bank under the project, can significantly change in 1) community relations with an intensive engagement in community waste management, 2) economic perspective as it generates employment and income, and reduces transportation costs for landfilling, and 3) environment term, as it reduces household waste and waste disposal. The suggestions have been developed in terms of policies and action plans for community waste management together with local administrative organizations to develop Tan Diao Subdistrict as a model of waste management.

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Introduction

According to the data on waste situations, the quantity of waste in the country tends to increase annually. In Thailand, the total quantity of solid waste was 27.93

million tons (Mt) in 2018, and 28.71 Mt in 2019 [1] with a trend to increase in the future. Therefore, the government sector has attempted to manage the increasing quantity of waste by decentralizing authority to

local government organizations. According to the Determining Plans and Process of Decentralization to Local Government Organization Act, B.E. 2542 (1999), and Amendment No. 2, B.E. 2549 (2006), the local government organizations are authorized and responsible for maintaining the cleanliness and orderliness of communities. In addition, the Enhancement and Conservation of National Environment Quality Act, B.E. 2535 (1992), requires the local government organizations to participate in supervising, preventing, and solving environmental problems in communities. However, many local government organizations have been faced with the problem of increasing amounts of waste which are too difficult to be managed, causing waste management in the past to be inefficient.

Due to the crisis of the waste problem, the government has declared the waste problem as a national issue requiring sustainable waste management. The focus is on reducing waste generation from the beginning, working towards the final step to drive Thailand as a zero-waste society under the National Solid Waste Management Master Plan, B.E. 2559–2564 (2016–2021). In addition, the Twelfth National Economic and Social Development Plan, B.E. 2560–2564 (2017–2021), was prepared to accelerate management for solving problems of accumulated waste in critical areas; to drive laws and mechanisms for waste sorting; to support waste conversion to produce energy, and to improve people's discipline for sustainable waste management (Prime Minister's Delivery Unit, 2020). Moreover, guidelines for sustainable waste management are specified in the new economy model known as the BCG (Bio-Circular-Green) model which is important in expediting national development, and defined the government policy on the development of the Thai economy and competitiveness in 2018. The development under the concept of BCG involves 3 dimensions, namely bioeconomy, circular economy, and green economy, by applying science, technology, and innovation for enhancing sustainable competitiveness.

However, the main factors affecting the waste management problems are that people in the area have not received the necessary awareness and knowledge in continuous waste management, they have never been developed to be a model leader in waste management, and there is lack of concrete integration for participation in waste management. This is consistent with the study of Berliyanti et al. [2] in evaluating the social return of Cirapuhan Village's waste management in Indonesia. This previous study found that the main problem of waste management was due to a lack of success in drawing participation of local people. Similarly, the study of Chanta et al. [3] assessed the social return on public

goods provision by Nong Hoi Subdistrict Municipality, Mueang District, Chiang Mai Province. The study found that the factor causing ineffective waste management was due to there being too much waste for the personnel and budgets of the government organizations to manage. Therefore, this led to the campaign of waste separation and family savings for future happiness according to the philosophy of His Majesty the King in order to foster awareness and knowledge of household waste management by changing recyclable waste into extra income for the people in the community.

The waste management in Tan Diao Subdistrict, Kaeng Khoi District, Saraburi Province is under the responsibility of Tan Diao Subdistrict Administrative Organization (SAO). According to the solid waste survey of the Pollution Control Department, the current amount of waste in Tan Diao Subdistrict continuously increased from 9.41 tons per day in 2018 to 12 tons per day in 2019 and 14.81 tons per day in 2020. However, the average waste collection and disposal is 12 tons per day which include reused waste 2.81 tons of waste per day [4]. The remaining 17,460 tons of residual solid waste are not eliminated. In 2018, the "Development of Systematic and Sustainable Waste Management Integration Project in Tan Diao Community Phase 1" was funded and supported by Chulalongkorn University to transfer knowledge in solving the community's waste problems at the source as a model of household waste sorting. This project has provided training for creating the body of knowledge, and implemented community waste banks in the Moo 7 and Moo 8 Villages in Tan Diao Subdistrict since 2019. Accordingly, the project could reduce the amount of recyclable waste by 1 ton and create value from selling recyclable waste amounting to more than 5,000 Thai Baht (138.54 USD). In sorting waste and selling recyclable waste of the community waste banks in the Moo 7 and Moo 8 Villages, plastic waste consisted of: 1) PETE (Polyethylene Terephthalate) such as bottles and pump bottles of drinking water, shampoo, liquid soap, and lotion; 2) HDPE (High-Density Polyethylene) such as bottles of shampoo, lotion, or various solutions; 3) PVC (Polyvinyl Chloride) such as water pipes, electrical wire insulation, and clear rubber hoses, and 4) PP (Polypropylene) such as boxes, dishes, yoghurt cups, sauce bottles, pill bottles, shampoo bottles, and bottles made of glass, metal, and paper, etc.

The community waste banks were implemented at the Moo 7 and Moo 8 Villages during 2020–2022 under the Learning Centre of Systematic Waste Management Innovation According to the Circular Economy Concept. The research team set the research problems as follows.

1. How can participation of all sectors be created in effective waste management in the area?

2. How can the sorted household waste create benefits or value?

The research team aimed to assess the social return on investment (SROI) from the community waste bank implementation on the basis of all sectors' participation to reflect social outcomes and benefits, indicating creation of benefits and value added from waste management in Tan Diao Subdistrict, and to develop policy recommendations useful for developing plans or action plans in community waste management of the local administrative organization.

In the community waste bank implementation, under the Learning Centre of Systematic Waste Management Innovation According to the Circular Economy Concept, can contribute the changes as follows. First, it illustrates the transformation of community waste management in terms of economic, community relations, and environment, for example, it helps reduce household waste, waste disposal and transportation costs, generate income from waste separation, increase community participation in community waste management, and reduce landfilling as it is found that the implementation result could create net present value at 106,166.60 Thai Baht (2,941.76 USD), in total, and SROI at 2.65 Thai Baht (0.073 USD). Second, it creates participation in effective waste management at Tan Diao Subdistrict under the Learning Centre of Systematic Waste Management Innovation According to the Circular Economy Concept. Moreover, suggestions have been developed in terms of policies and action plans for community waste management together with local administrative organizations to develop Tan Diao Subdistrict as a model of waste management.

Research methodology

This research was participatory action research (PAR) by using SROI as an instrument. SROI is widely used in many countries, starting from the USA before expanding to the European region and the United Kingdom [5]. SROI aims to assess the impacts of a particular organization or project on society, especially with a project relating to waste management [6]. At present, the trend is to use public resources in a financially responsible manner for implementing each project. Philip Morris International (PMI) (n.d.) applied impact valuation and social return on investment methodologies to PMI's Waste Bank project in Indonesia [7] to show how to create social and environmental value throughout the value chain. This previous study pointed out how to combine qualitative and quantitative research methodologies in data collection for implementing SROI, and showed the results from arranging the waste bank, i.e., reducing leakage of plastic waste into the ocean, and

creating more income for the community. For every dollar invested in the project, the social benefit was equivalent to 6 USD. The distinction of the SROI instrument is its ability to convert social and environmental outcomes into financial figures, making them tangible and easy to use for making decisions. Moreover, the use of a qualitative method enables details to be obtained which cannot be received by only using the quantitative method [8]. Therefore, it can be said that SROI is an instrument for measuring and calculating social value in economic, social, and environmental dimensions [9].

The assessment of SROI under the community waste bank implementation of the Moo 7 and Moo 8 Villages during 2020–2022 was conducted by using 1) a quantitative method to convert social values or outcomes of change arising in a society into financial proxy values through cost-benefit analysis from secondary data, and 2) a qualitative method through documentary research, group discussions, in-depth interviews, and PAR. The framework was for assessing social values as the financial proxy, and developing indicators of results from the community waste bank implementation at the Moo 7 and Moo 8 Villages. The study procedures are presented in Figure 1 below.

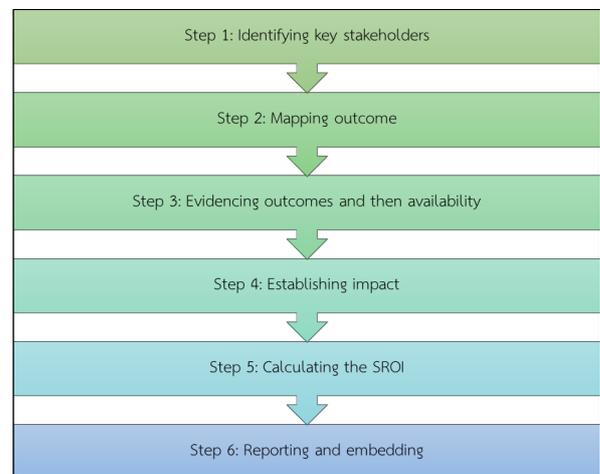


Figure 1 The procedures of the SROI analysis.

The data collection was implemented with the quantitative method, qualitative method, and PAR. The implementation included documentary research on community waste management plan, secondary data on waste statistics report, focus groups, in-depth interviews on total cost for investment and income from selling recyclable waste with 40 participants, including 25 community members from Moo 7–8, 5 leaders as village chiefs, 3 representatives from Tan Diao SAO, 5 village health volunteers, and 2 private waste buyers, and conversion of social value or outcomes of change arising from the project implementation into

financial proxy values through analysis of net present value, cost-benefit analysis, and SROI calculation at the discount rate based on the government bonds at 3%.

The research team performed the cost-benefit analysis to analyze the effectiveness of public expenditure by assessing the costs and benefits of the project. The project cost or expense was in two types: 1) direct cost for investment, i.e. capital cost and operation cost, and 2) indirect cost, not direct cost for investment but project loss which is called “opportunity cost”. On the other hand, the benefits or returns from the project similarly arose in two types: 1) direct benefits, and 2) indirect benefits both in financial and non-financial forms which differ from profit because business profit is only calculated from finances but benefits are calculated from the government’s expenses or social activities. Benefits can be defined either in a financial or non-financial form. Benefits belong to the whole society, instead of any particular person. After knowing all costs and benefits, the next step was to analyze cost effectiveness by using the cost-benefit analysis as follows [10].

1) Net present value (NPV) refers to difference between present value benefit (PVB) expected to be received each year throughout the project period and present value cost (PVC). The criterion to consider for the NPV was that the project was suitable for investment when the $NPV > 0$ or had a positive value. In other words, the present value benefit should be more than the present value cost ($PVB > PVC$).

2) Benefit - cost ratio (B/C Ratio, or BCR) refers to the ratio of present value benefit throughout the project period to the present value cost throughout the project period. The criterion to consider for the B/C ratio was that investment should be made when the BCR was more than or equivalent to 1, but investment should not be made when the BCR was less than 1.

3) Internal rate of return (IRR) was an interest rate which made the project’s net present value equivalent to 0. The criterion to consider for the IRR was that the project investment was acceptable when the calculated IRR was compared with and was higher than the discount rate.

4) Payback period (PP) was an analysis about the period to receive the investment back. The criterion to consider for the PP was that a shorter PP was the better, but this was dependent on the project type.

In the quantitative analysis, the research team analyzed the SROI in the 6 steps of the research procedures as mentioned earlier. The standard instrument of the investment analysis was applied to find the social, environmental, and economic values. The first 3 steps dealt with value assessment and the change of an organization’s present value of impact on society,

environment, and economy into financial proxy values. This led to the organization’s “blended value” which consisted of business value and social value. In Steps 4–6, these values were compared with the desired investment by dividing each type of value to be an indicator of whether that investment would be successful or not. The different indicators and analysis processes were presented in the report of impact on stakeholders. The social return was calculated according to the following Eq. 1.

$$SROI = \frac{(\text{Present Value of Impact})}{\text{Value of Inputs}} \quad (\text{Eq. 1})$$

Results and discussions

The results in all six steps of the SROI assessment of the community waste banks in the Moo 7 and Moo 8 Villages during 2020–2022 under the Learning Centre of Systematic Waste Management Innovation According to the Circular Economy Concept project are described below.

Step 1: Identifying key stakeholders

In the stakeholder analysis of the community waste banks implementation at the Moo 7 and Moo 8 Villages during 2020–2022 under the Learning Centre of Systematic Waste Management Innovation According to the Circular Economy Concept project, the research team performed the stakeholder analysis by dividing the stakeholders into three main groups according to their roles as follows.

- (1) Key stakeholders
- (2) Primary stakeholders
- (3) Secondary stakeholders

In addition, the stakeholders were considered in two main points.

- (1) Stakeholders’ importance in supporting and driving the implementation
- (2) Stakeholders’ influence

The research team used the matrix of relationships between importance and influence of the stakeholders through a focus group among stakeholders in all sectors in order to consider the roles of each stakeholder group.

The implementation of the community waste bank in Moo 7 and Moo 8 Villages during 2020–2022 included 5 groups of the stakeholders as shown in the following Table 1.

Then the research team analyzed the influence and importance in supporting mobilization of the stakeholders. The matrix was used to analyze the relationships between influence and the importance of the stakeholders, as summarized in Table 2.

Table 1 The stakeholders of the community waste banks in the Moo 7 and Moo 8 Villages during 2020 – 2022 under the Learning Centre of Systematic Waste Management Innovation According to the Circular Economy Concept project

Stakeholders	Roles
1. 40 people in Moo 7 and Moo 8 Villages, Tan Diao Subdistrict	<ul style="list-style-type: none"> - Joining the training of knowledge transfer according to the program of the community waste bank. - Taking roles and duties in waste sorting at the household level. - Sorting waste according to the steps learned from the training about waste sorting. - Implementing the community waste bank and selling recyclable waste.
2. Community leaders (Village Chiefs) of Moo 7 and Moo 8 Villages	<ul style="list-style-type: none"> - Joining the training of knowledge transfer according to the program of the community waste bank. - Taking roles and duties as the committee chairman in waste management of the Moo 7 and Moo 8 Villages in Tan Diao Subdistrict; manage the community waste bank; do public relations with the public sector; and develop a model of the community waste bank. - Running campaigns for raising awareness of local people on the importance of household waste sorting. - Creating motivation to earn income from selling recyclable waste to local private waste buyers
3. Tan Diao Subdistrict Administrative Organization (SAO)	<ul style="list-style-type: none"> - Arranging local sub-committee for supporting academic matters by setting activity schedule for the whole year in the forms of trainings and demonstration about waste sorting. - Setting activities for reducing community waste. - Assessing community potential, leading to criteria setting for sustainability of activity arrangement for reducing community waste. - Collaborating with the research team to plan the community waste bank implementation.
4. Village volunteers	<ul style="list-style-type: none"> - Joining the training of knowledge transfer according to the program of the community waste bank. - Taking roles and duties in the community waste bank implementation at the Moo 7 and Moo 8 Villages, Tan Diao Subdistrict, and being a model for waste management in the community. - Being a key motivator at the household level who promotes and educates in waste sorting and management knowledge.
5. Private waste collectors	<ul style="list-style-type: none"> - Both major and minor waste collectors respond in collecting waste from local people. - Coordinating with factories for managing each type of waste.

Table 2 The matrix of relationship between influence and importance of the stakeholders

Factors		Influence	
		Little	Much
Importance	Major	<ul style="list-style-type: none"> • People in Moo 7 and Moo 8 Villages • Tan Diao Subdistrict (P) 	<ul style="list-style-type: none"> • Tan Diao Subdistrict Administrative Organization (K) • Village Volunteers (K) • Community Leaders (Village Chiefs of Moo 7 and Moo 8) (K)
	Minor		<ul style="list-style-type: none"> • Private Waste Buyers (S)

Note: K: key stakeholders, P: primary stakeholders, S: secondary stakeholders

According to Table 2, the stakeholders with high importance and high influence in mobilizing the community waste banks in the Moo 7 and Moo 8 Villages consist of 1) Tan Diao SAO, 2) village volunteers, and 3) community leaders (village chiefs of the Moo 7 and Moo 8 Villages). Tan Diao SAO was considered as the key stakeholder because SAO took legal responsibility for managing waste in the area, providing knowledge, training, and demonstrations about waste sorting, and

arranging activities to reduce waste in the community. Village volunteers were considered as the main drivers to mobilize the community waste bank implementation in the Moo 7 and Moo 8 Villages in Tan Diao Subdistrict. Community leaders (village chiefs of the Moo 7 and Moo 8 Villages) were also important in creating a process of community participation, doing public relations, and providing a model of household waste sorting.

In another group, the stakeholders with high importance but low influence in the project implementation were people in the Moo 7 and Moo 8 Villages in Tan Diao Subdistrict. Although participation of local people was an important part in measuring the success of the community waste bank implementation during 2020–2022, especially in household waste sorting, this stakeholder group was regarded as primary stakeholders who got either positive or negative effects from the project activities. On the other hand, the private waste collectors were considered as secondary stakeholders as they were indirectly related to the project implementation.

In conclusion, there were three main stakeholder groups in the stakeholder analysis in driving the learning base of the community waste bank under the Learning Centre of Systematic Waste Management Innovation According to the Circular Economy Concept in Tan Diao Subdistrict, Kaeng Khoi District, Saraburi Province as follows.

(1) Key stakeholders consisted of Tan Diao SAO, village volunteers, and community leaders (village chiefs).

(2) Primary stakeholders were people in Moo 7 and Moo 8 Villages in Tan Diao Subdistrict.

(3) Secondary stakeholders included private waste buyers.

Step 2: Mapping outcomes

The focus group was arranged to consider input through activities, leading to concrete measurable output. The outcomes / impact from the community waste bank implementation in Moo 7 and Moo 8 Villages during 2020–2022 are summarized in mapping outcome shown in the following Table 3.

Step 3: Evidencing outcomes and then availability

This step is to examine outcome and assess value to point out changes arising with the stakeholders in all sectors (Theory of Change) who participated in mobilizing the community waste bank implementation to consider co-outcomes, indicators, and measuring methods, as summarized in Table 4.

Table 3 Mapping outcomes

Stakeholders	Input	Activities	Output	Outcome
1. People in the Moo 7 and Moo 8 Villages at Tan Diao Subdistrict	- Training with 40 participants - Supporting the implementation of the community waste bank in Moo 7 and Moo 8 Villages (in 2020 – 2022) with 40,000 Thai Baht fund.	- Participating in waste-sorting training. - Sorting household waste and selling recyclable waste. - Implementing the community waste bank. - Managing the community waste bank and public relations.	- More income from selling recyclable waste. - Network expansion of household waste sorting in communities. - Body of knowledge and knowledge transfer among villages in Tan Diao Subdistrict. - Lower waste amount in the Moo 7 and Moo 8 Villages.	- Money saving and reduced household expenses. - Better community environment. - Lower community waste. - Pride - Creation of circular economy in the communities.
2. Community leaders (village chiefs) of the Moo 7 and Moo 8 Villages		- Acting as community chairmen and committee in managing the community waste bank in the Moo 7 and Moo 8 Villages. - Being a model of waste sorting. - Arranging campaigns and public relations.	- Lower waste amount in the communities. - Management of the community waste bank to gain average income of more than 5,000 Thai Baht/year (except during the COVID-19 pandemic according to the government measures).	- Cultivation of awareness on waste value and environmental preservation. - Motivation in waste sorting of the younger generation. - Income for members of the community waste bank. - Better environment in the community. - Strengthened communities in waste management.
3. Village volunteers		- Participating in waste-sorting training. - Sorting household waste and selling recyclable waste. - Managing the community waste bank and public relations.	- Be mainstays in transferring knowledge among villages in Tan Diao Subdistrict. - Reduced amount of waste in the Moo 7 and Moo 8 Villages.	- Better community environment. - Lower community waste. - Pride - Creation of waste-sorting networks. - Creation of circular economy in the communities. - Mainstays in expanding the network of household waste sorting in the communities.

Table 3 Mapping Outcomes (*continued*)

Stakeholders	Input	Activities	Output	Outcome
4. Tan Diao SAO		<ul style="list-style-type: none"> - Arranging knowledge-sharing activities with the research teams about managing each type of waste for sustainable waste management in the communities (training and demonstrations about waste-sorting). - Arranging educational visits at the model areas for waste sorting with the research teams and community representatives to observe and study the model areas for waste management at the national level at Ban Rang Phlub Community, Krub Yai Subdistrict, and Ban Pong District, Ratchaburi Province. 	<ul style="list-style-type: none"> - Lower expenses on waste management. - Lower community waste. - Plans and strategies for community waste management. 	<ul style="list-style-type: none"> - Lower residual waste in the areas. - Work according to SAO's indicators. - Guidelines for further development of a model community for waste management. - Result expansion to other communities. - Good relationships in the communities.
5. Private waste buyers		<ul style="list-style-type: none"> - Buying waste from the communities. 	<ul style="list-style-type: none"> - More waste amounts to buy from the community waste bank in the Moo 7 and Moo 8 Villages. 	<ul style="list-style-type: none"> - Income from buying waste. - Participation in community waste management. - Promotion of waste management in a complete cycle under the circular economy concept. - Creation of careers and income for small waste sellers.

Table 4 Indicators of the community waste bank implementation in Moo 7 and Moo 8 Villages during 2020–2022

Stakeholders	Co-outcomes	Indicators	Measuring Methods
1. People in the Moo 7 and Moo 8 Villages in Tan Diao Subdistrict	<ul style="list-style-type: none"> - More income from selling recyclable waste. - Better community environment. 	<ul style="list-style-type: none"> - Income from selling recyclable waste. - Clean community with lower waste amounts in the bins. - Sorting each type of waste such as recyclable waste, hazardous waste, and infectious waste. 	<ul style="list-style-type: none"> - More income from selling recyclable waste per year. - Number of waste-sorting bins in the communities.
2. Community leaders (village chiefs)	<ul style="list-style-type: none"> - Strengthened the community in waste management. 	<ul style="list-style-type: none"> - Community increasingly gathering to do activities (training and demonstrations about waste sorting). 	<ul style="list-style-type: none"> - Number of meeting arrangements per year (times/year). - Number of waste management activity arrangements per year (times/year). - Number of households participating in the project per year (number of households/year).
	<ul style="list-style-type: none"> - Income of members participating in the community waste bank. 	<ul style="list-style-type: none"> - Lower household waste amounts. - Household waste sorting. - Income from selling recyclable Waste. 	<ul style="list-style-type: none"> - Lower waste amounts per year. - Amount of income from selling recyclable waste in the communities per year (baht/year).
3. Village volunteers	<ul style="list-style-type: none"> - Being mainstays in expanding the household waste sorting networks in the communities. 	<ul style="list-style-type: none"> - More networks in household waste management. - Participation of village volunteers, district health promotion hospitals, community leaders, municipality, temples, and schools. 	<ul style="list-style-type: none"> - Number of households participating per year. - Number of meeting and activity arrangements with integration from all sectors per year.

Table 4 Indicators of the community waste bank implementation in Moo 7 and Moo 8 Villages during 2020–2022 (*continued*)

Stakeholders	Co-outcomes	Indicators	Measuring Methods
3. Village volunteers (continued)	- Pride and happiness from the project participation.	- Number of invitations to be guest speakers. - Number of meeting and activity arrangements. - Number of working hours in the project (baht/working hour) . - Lower amount of general and recyclable waste in the households.	- Number of invitations to be guest speakers. - Lower amounts of general and recyclable waste in the communities (tons/year) . - Number of training hours in the project (baht/working hour) .
4. Tan Diao SAO	- Work according to indicators.	- Assessing results according to SAO's key performance indicators (KPIs) of waste management.	- Assessment according to SAO's indicators of waste management.
5. Private waste buyers	- Income from buying recyclable waste.	- Profit from buying waste in the communities.	- Income after cost deduction from buying recyclable waste per year.

Step 4: Establishing impact

According to the focus group of the stakeholders in the community waste bank implementation in the Moo 7 and Moo 8 Villages, the main co-outcomes from the project implementation were considered in two issues: income from selling recyclable waste from the Moo 7 and Moo 8 Villages, and pride and happiness from project participation. However, many social projects were implemented by other organizations from the government, public, and private sectors with the focus on making changes in those areas on the same issues, whereas SAO with direct responsibility continuously attempted to improve and solve waste problems in the areas. Therefore, in assessing SROI, consideration should be placed upon the following cases.

- Some outcomes might be attributed to other organizations.

- Outcomes and deadweight might occur as some changes arise without any project implementation, reflecting that outcomes could occur in a better direction even though there was no implementation from any organization, but instead due to the stakeholders' implementation by themselves or due to the supportive conditions of the economy and society.

Regarding the deadweight, this was not found since there had never been a community waste bank project in the area before. As some outcomes might attributed to other organizations, it was found that the local government organizations performed their duties according to their roles and missions. Therefore, the stakeholders of the projects agreed that attribution to other organizations' implementation should be deducted at 10% as summarized in the following Table 5.

According to Table 5, suitable indicators of social outcomes, measuring methods, and social outcome

calculations according to indicators after deducting effects from the project implementation can be summarized as follows.

1) Outcome of Income from selling recyclable waste of Moo 7 and Moo 8 Villages

The income from selling recyclable waste from the Moo 7 and Moo 8 Villages during 2020–2022 was at the value of 5,622.52 Thai Baht/year (155.79 USD/year). Regarding deadweight, some outcomes which might be attributed to other organizations were considered at 10%, and the total value from selling recyclable waste from the community waste bank in Moo 7 and Moo 8 during 2020–2022 was 5,060.27 Thai Baht/year (140.21 USD/year).

2) Outcome of pride and happiness from the project participation

Pride and happiness from the project participation were considered with the conversion method into financial proxy values by calculating working hours, minimum wages obtained from devoting time to work, and number of training hours at the community waste bank [3]. The outcome of pride and happiness from the project participation was found at the value of 51,000 Thai Baht/year (1,413.15 USD/year).

When considering deadweight and some outcomes which might be attributed to other organizations at 10% of the total value, pride, and happiness from the project participation in the waste bank project of Moo 7 and Moo 8 during 2020–2022 was 45,900 Thai Baht/year (1,271.84 USD/year).

In conclusion, the co-outcome from the community waste bank in the Moo 7 and Moo 8 Villages was at the value of 50,960.27 Thai Baht/year (1,412.05 USD/year).

Table 5 Suitable indicators of social outcomes, measuring methods, social outcome calculation according to indicators after deducting effects from the project implementation

Outcomes / Impacts	Indicators	Proxies	Dead Weight		Attribution		Total Value (Thai Baht)
			Percent	Balance	Percent	Balance	
Income from selling recyclable waste of Moo 7 and Moo 8 Villages	Income from selling recyclable waste.	Income from selling recyclable waste of Moo 7 and Moo 8 Villages (in 2020 – 2022) at the average of 5,622. 52baht/year	-		10	5,060.268	5,060.27
Pride and happiness from the project participation	- Number of invitations to be guest speakers. - Number of training hours in the project (baht/working hours) .	Pride value of the project participants calculated from training hours and minimum wages in the area of Kaeng Khoi District, Saraburi Province in 2020 – 2022 (340 baht/day) with 30 training hours and 40 trainees, accounted for 51, 000baht/year	-		10	45,900	45,900
Total Value							50,960.27

Step 5: Calculating the SROI

In this step, the SROI from the community waste bank implementation in the Moo 7 and Moo 8 Villages under the Learning Centre of Systematic Waste Management Innovation According to the Circular Economy Concept was calculated by considering the 3-year period of the project implementation during 2020–2022 through the analysis of net present value with the discount rate, cost-benefit analysis, payback period, and SROI ratio. The study results are described as follows.

The community waste banks implementation in the Moo 7 and Moo 8 Villages during 2022–2022 had the total cost during 3 years with investment of 40,000 Thai Baht (1,108.36 USD). After deducting deadweight and attribution, the return of the project included income from selling recyclable waste and outcomes of pride and happiness from project participation. The total return from the 3-year projects was 152,880.80 Thai Baht (4,236.16 USD) and the net income from the project implementation was 112,880.80 Thai Baht t (3,127.80 USD) at the discount rate according to the return rate of the government bonds at 3%.

The net present value of benefits or achievements for 3 years was calculated at the 3% discount rate, and the total net present value was found at 106,166.60 Thai Baht (2,941.76 USD). In the cost-benefit analysis, the calculated result was at 12.74 times and the payback period was at 4.7 months.

According to the project assessment with net present value, the calculated result was in a positive value with the value of the cost-benefit analysis more than 1 and the payback period shorter than the project period. Therefore, it can be concluded that the implementation of the community waste banks in the Moo 7 and Moo 8 Villages during 2020–2022 under the Learning Centre of

Systematic Waste Management Innovation According to the Circular Economy Concept is worthy of investment.

The SROI from the community waste banks implementation in the Moo 7 and Moo 8 Villages during 2020–2022 was calculated from the net present value of 106,166.60 Thai Baht (2,941.76 USD), and the total cost of 40,000 Thai Baht (1,108.36 USD), accounted for the value of 2.65 times. In other words, every 1 Thai Baht (0.028 USD) of investment for the community waste banks in the Moo 7 and Moo 8 Villages during 2020–2022 under the project to develop the Learning Centre of Systematic Waste Management Innovation According to the Circular Economy Concept can provide social benefits at 2.65 Thai Baht (0.073 USD), as summarized in the following Table 6.

Regarding the results of the SROI study in the community waste bank implementation at the Moo 7 and Moo 8 Villages during 2020–2022 by using the discount rate at 3% of the government bond, the net present value was found to be 106,166.60 Thai Baht (2,941.76 USD). In the cost-benefit analysis, the calculated result was 12.74 times, the payback period was 4.7 months, and the social return was assessed at 2.65 Thai Baht (0.073 USD). In other words, every 1 Thai Baht of investment for the community waste banks in the Moo 7 and Moo 8 Villages during 2020–2022 under the project to develop the Learning Centre of Systematic Waste Management Innovation According to the Circular Economy Concept could provide social benefits at 2.65 Thai Baht (0.073 USD). Therefore, it can be concluded that the implementation of this community waste banks in the Moo 7 and Moo 8 Villages during 2020–2022 is worthy of investment with its contribution to social benefits.

Table 6 The study results in assessing SROI from the community waste bank implementation under the project to develop the Learning Centre of Systematic Waste Management Innovation According to the Circular Economy Concept at the Moo 7 and Moo 8 Villages in Tan Diao Subdistrict, Kaeng Khoi District, Saraburi Province

Stakeholders	Benefit value (Thai Baht)	Benefit proportion (%)
1. Benefits of stakeholders per year		
- People in Moo 7 and Moo 8 Villages, Tan Diao Subdistrict, community leaders (village chiefs), and village volunteers	122,304.64	80.00
- Tan Diao Subdistrict Administrative Organization	15,288.08	10.00
- Private waste buyers	15,288.08	10.00
Total	152,880.80	100
2. Net present value (3 years)	106,166.60 baht	
3. Cost-benefit Analysis (BC Ratio) (3 years)	12.74 times	
4. Payback period (3 years)	4. 7months	
5. SROI rate (3 years)	2.65 times	
	(Every 1 Thai Baht of investment for the community waste bank in Moo 7 and Moo 8 Villages during 2020 2022 under the project to develop the Learning Center of Systematic Waste Management Innovation According to the Circular Economy Concept can make social benefit at 2.65 Thai Baht.	

The stakeholders had the benefit values in proportion as follows: 1) community members, community leaders (village chiefs), and village health volunteers in the Moo 7 and Moo 8 Villages had the benefit value at 122,304.64 Thai Baht (3,388.93 USD) and the benefit proportion at 80%; 2) Tan Diao SAO had the benefit value at 15,288.08 Thai Baht (423.62 USD) and the benefit proportion at 10%, and 3) The private waste buyers had the benefit value at 15,288.08 Thai Baht (423.62 USD) and the benefit proportion at 10%. as summarized in the following Figure 2.

Therefore, the establishment of community waste banks in Moo 7 and 8 offers significant benefits to all stakeholders, both in economic, social, and environmental aspects. These benefits include job creation, income distribution within the community, promotion of awareness and knowledge in waste management, reduction of household waste, and encouragement of participation in waste management activities. This is consistent with the SROI case study of the waste management model of Ban Sanchokpok by Phaokruang et al. [11], which shows that investing 1 Thai Baht (0.028 USD) will create benefits to society worth 1.04 Thai Baht (0.029 USD). The community waste bank can generate benefits to society in terms of waste management and income generation, as seen in Phimai

DHB, Nakhon Ratchasima Province, Thailand [8] through waste management and environment issues supported by District Health Board (DHB). Every 1 Thai Baht (0.028 USD) invested in activities related to waste management and the environment results in a social return worth 7.52 Thai Baht (0.029 USD) demonstrating the benefits in terms of economics, society, and the environment. Operations that involve the participation of all stakeholders in various sectors, including government sector, the public sector, and the private sector, create a model community for waste management from the household level. These improvements in waste management contribute to a cleaner and healthier community environment. Moreover, additional value is created from waste, such as generating income from selling recycled waste, using organic waste to make fertilizer for agriculture, and raising animals to reduce farming costs and create additional income from selling duck eggs, chickens, and wild boars. This positive impact is reflected in the study of the Smart Waste Bank Program Mining by Industry Indonesia (2023), which focuses on raising public awareness about waste problems. The Smart Waste Bank, through selling waste, creates a social impact worth 2.64 USD for every 1 USD invested, thus increasing people's income and promoting a good waste management system in the community.

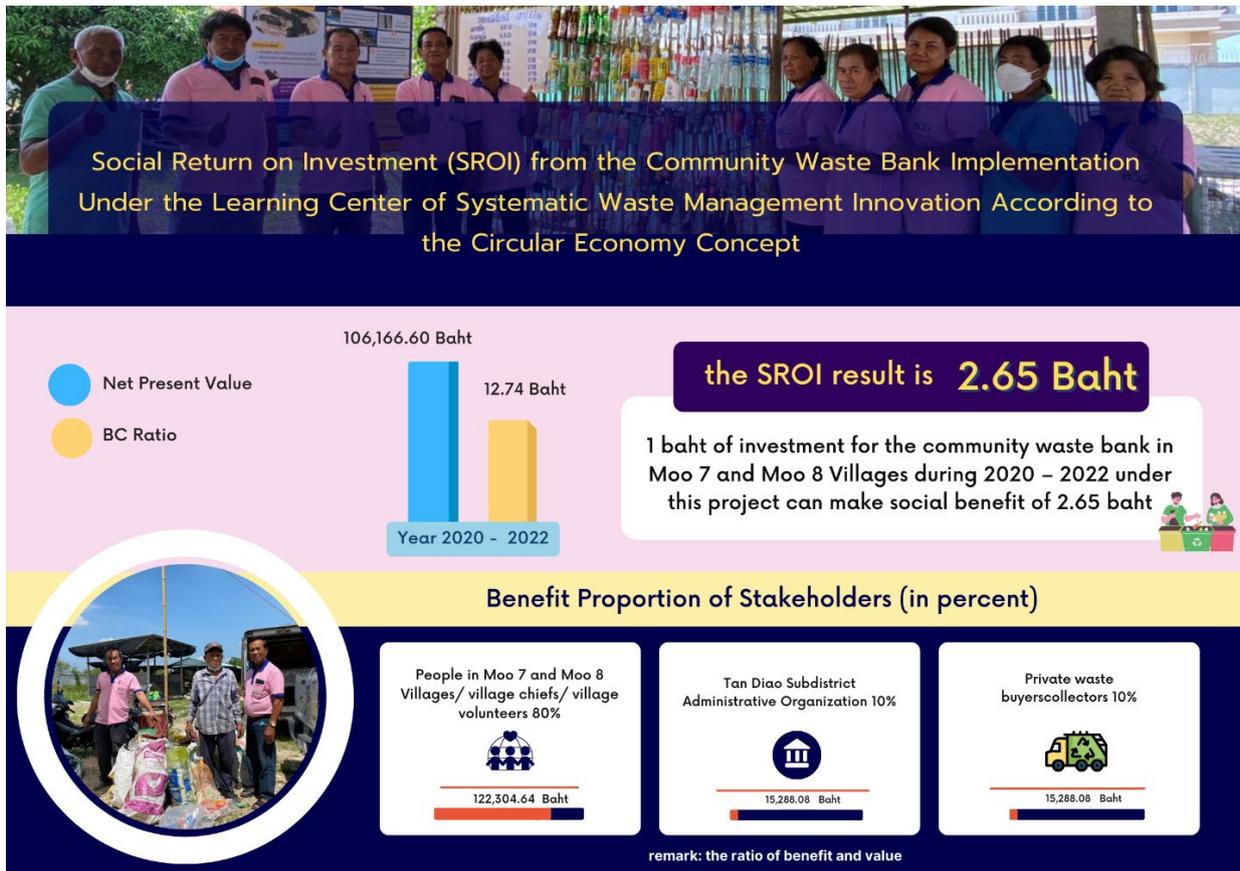


Figure 2 Summary of the SROI assessment.

However, the investment evaluation results from social return on investment of the Ruam Jai Waste Bank Recycling project by Saranritthichai et al. [12] show inconsistencies. The social return on investment from the project is equal to -0.85, indicating that every 1 Thai Baht (0.028 USD) invested in various activities results in a social return at -0.85 Thai Baht (-0.024 USD) This implies business operations that incur losses or do not create additional social value due to the high costs of operating a waste bank from employment. This is different from this project, which was created through the participation of local people in operating a community waste bank. However, the establishment of a waste bank can foster indirect benefits for both the community and individuals involved, such as reducing the amount of waste generated in the community, enabling community members to use their free time productively, contributing to good mental health and well-being, and strengthening relationships within the community.

Conclusions and recommendations

The SROI from the community waste bank implementation under the project to develop the Learning Centre of Systematic Waste Management Innovation According to the Circular Economy Concept at the Moo 7 and Moo 8 Villages in Tan Diao Subdistrict, Kaeng Khoi District, Saraburi Province was assessed by

using a 3% discount rate according to the return rate of government bonds. In the cost-benefit analysis, the calculated result was 12.74 times, the payback period was 4.7 months, and social benefit was 2.65 Thai Baht (0.073 USD). In other words, every 1 baht of investment for the community waste banks in the Moo 7 and Moo 8 Villages during 2020–2022 under the project to develop the Learning Centre of Systematic Waste Management Innovation According to the Circular Economy Concept can provide social benefits at 2.65 Thai Baht (0.073 USD). Therefore, it can be concluded that the implementation of the community waste banks in the Moo 7 and Moo 8 Villages during 2020–2022 under the Learning Centre of Systematic Waste Management Innovation According to the Circular Economy Concept is worthy of investment with its contribution to social benefits.

In addition, the research team arranged a focus group for developing policy suggestions together with the stakeholders and Department of Local Administration to manage community waste in more effective ways, and to implement the Learning Centre of Systematic Waste Management Innovation According to the Circular Economy Concept. The authors arrange the policy suggestions as follows.

Support coordination among communities and the Learning Center of Systematic Waste Management Innovation to increase participation in relieving burden on waste management in the area, reducing residual

waste problem in the communities, and having guidelines for systematically managing waste together.

1. Amend laws about solid-waste collection and disposal in accordance with cost of waste management in the whole system and increase enforcement of laws relating to cleanliness in a more effective way.

2. Increase support in building participatory process among government organizations, private sector, educational institutions, religious places, village chiefs, and local people for increasing waste management at sources, finding guidelines for utilizing each type of waste through coordination with the Learning Center of Systematic Waste Management Innovation, creating more networks with the private sector for managing orphan waste such as plastic bags which can be used for making concretes and roads (SCG Company).

3. Support arrangement of campaigns and public relations for creating awareness and promoting disciplines in “sorting waste before throwing away” and principle of 3Rs (reduce, reuse, recycle) with the target at children, youths, educational personnel, organizational administrators, and village leaders to be a good model.

4. Support organizational personnel and local people to study at model organizations or communities about waste management in a complete cycle and support intensive participation.

5. Increase more collecting hubs at various points for collecting and sorting plastic waste, sending it to the community waste bank, and giving suggestions at the citizen level.

6. Support knowledge transfer about managing each type of waste in 5 learning bases to people in and nearby the areas.

7. Support application of technology and innovation in the community such as applications useful for managing the community waste bank, and transferring knowledge how to manage plastic-packaging waste at households etc.

8. Arrange for household waste management such as organic waste, recyclable waste, and infectious waste etc.

9. Arrange a database regarding types of waste with community participation and develop digital platforms for collecting data useful for effectively utilizing waste.

10. Local government organizations should arrange effective waste databases useful for planning and utilizing waste in a more concrete way with more value added such as utilizing waste to produce alternative energy in the community etc.

11. Apply systematic waste management in the Learning Center to transfer knowledge continuously to people in the area and nearby areas.

Limitations of the SROI assessment

The limitations of the SROI assessment are as follows.

1. Data insufficiency: The implementation takes a lot of time and resources to obtain sufficient data for doing the SROI assessment. In the SROI calculation, if data are insufficient or a good follow-up system is unavailable, the results of the SROI assessment will be inaccurate. Therefore, to get the real results of the assessment, effective retrospective data collection is necessary.

2. Attention to each step of the assessment: The SROI assessment was performed in 6 steps to reflect changes arising from the project implementation, connection of activities, and reasonable outputs and outcomes of the project. These factors can be indicators to reflect real change from the project implementation. Therefore, the assessor needs to carefully consider different factors in each step to get accurate and real results of the assessment.

3. Financial proxy: The most difficult step is to find the most comparable financial proxy to value the results as accurately as possible. Therefore, the assessor must find the most consistent and reasonable financial proxy to be used as a reference for converting financial values to be reasonable and acceptable to all stakeholders in all sectors.

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