

The Management of Capital Allocation for Sustainable Municipal Solid Waste Management System: A Case Study of Bang Saen, Thailand

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Abstract

This paper attempted to analyze and understand the management of capital allocation for sustainable municipal solid waste management system at Bang Saen, Thailand. Financial, manufactured, human, social and natural capital was the focus of this study. Capital allocation to five capitals, activities of the stakeholders related to municipal solid waste management, and the output of these activities were analyzed. The investigation was carried out by reviewing documents, conducting in-depth interviews with various stakeholders including the Saensuk municipality officials, locals and tourists, and carrying out field observations. Results showed that total output from five capitals is influenced by activity performance of stakeholders, which is dependent on input to five capitals. However, input was made without assessments of output produced by the activities of the stakeholders, which stemmed from the absence of a policy goal on municipal solid waste management and action plans to achieve its goal. Capital was mostly allocated to financial and manufactured capitals in terms of support of municipal solid waste collection, transportation and disposal. Findings suggest that capital should be allocated to activities related to human, social and natural capitals that can help improve activity performance of the stakeholders, and therefore improve total output and sustainability of the system. Well-designed activities could generate improved output, which is made by readjusting input based on assessments of output and by reflecting feedback in decision making on capital allocation. For this reason, the municipality has to set a clear policy goal of municipal solid waste management, short-term, and long-term action plans. Finally, recommendation is given to municipality.

Keywords: capital allocation; sustainable municipal solid waste management system; Bang Saen; Thailand

1. Introduction

Generally, most municipal solid waste (MSW) managers tend to consider their activities in terms of tidiness, swiftness, and cost of collection, transportation and disposal of MSW. They tend to merely manage MSW without any policy goal of municipal solid waste management (MSWM) (UNEP, 2004; Koh, 2007; UN-HABITAT, 2010). The typical response to this is a symptom-oriented approach and an increasing government budget on MSWM particularly in developing countries (Hoornweg and Thomas, 1999). The study of capital allocation helps local government to diagnose the workings of the whole MSWM system and to reconsider their capital allocation to make the system more sustainable.

The Forum for the Future (2000) presented the five capitals framework to sustain activities of organizations in the long term. "Five capitals" are composed of natural, human, social, manufactured and financial capitals, which are needed to create and deliver products and services (Table 1). Consequently, any organization

needs to maintain and enhance a stock of these capitals to ensure long-term profitability (Porritt, 2007). Despite the emphasis on management of five capitals to sustain activities of organizations, scant attention has been paid to organizations such as local government bodies providing public services such as MSWM as a non-profit activity. Typically this framework focuses only on sustainability of activities of capitalist organizations that seek greater profits.

MSWM both directly and indirectly involves various stakeholders in societies, central; provincial and local government, waste workers, householders, small entrepreneurs, non-profit organizations (NPOs), itinerant waste buyers, and middle-men in waste recycling trade (JICA, 2005; UNEP, 2005). It is the stakeholders that cause problems in the system through activities that undermine the sustainability of the whole system. If the five capitals are properly allocated to support the activities of the stakeholders related to MSWM, they will generate more output (e.g. monetary value) than input, and vice versa. Although MSWM is a non-profit activity, generating more output than input

Table 1. Definitions of Five Capitals Based on the Forum of the Future (2000)

| Types of capital | Definitions |
|------------------|---|
| Financial | Money that is used to buy what they need to provide services and produce products and services |
| Manufactured | Tools, equipments, machines, buildings and other forms of infrastructure that contribute to the production process but do not become embedded in its outputs |
| Human | Health, knowledge, skill and motivation that are needed for productive work |
| Social | Structures, institutions, networks and relationships that enable individuals to maintain and develop their human capital in partnership with others and enable them to work more productive when they work together |
| Natural | Any stock or flow of energy and matter that yields valuable goods and services |

Source: Porritt (2007)

makes the system more self-support. Otherwise, local government needs more budget on MSWM to keep up the system. Viewed in this light, sustainable MSWM system needs to consider capital allocation to five capitals among all stakeholders to maximize output. Therefore, the objective of this research was set to understand how capital allocation should be managed as a means to maintain long-term management of MSW.

2. Study area and Methodology

2.1. Study area

This study was conducted in Saensuk town located on Chonburi Province in the Eastern Region of Thailand, approximately 90 kilometers from Bangkok. The town, more commonly known as Bang Saen, was established in 1943 as the first weekend resort for the Thai public. Bang Saen consists of 19 communities with a registered population of 43,840 people, as of 2010. The land area of the town is 20.268 km². The economy of Bang Saen is largely dependent on tourism. The majority of visitors travel by private car from Bangkok. There were 1,343,897 registered tourist arrivals in 2009 generating a revenue of 3.17 billion baht (1 USD = 30.80 Baht) (Saensuk municipality, 2010b). Bang Saen was chosen as a case study site because the development of tourism created a vicious cycle whereby MSW generated by tourism-related activities leads to a greater budget needed for spending on MSW collection, transportation and disposal. The consequence is that less budget is leftover for improving social and environmental problems (e.g. an increase in crime, tourism congestion, litter, water, air, noise, and visual pollution) caused by the expansion of tourism activities. This budget allocation eventually deteriorates the environment on which tourism activities are dependent. Places like Bang Saen are rapidly increasing in many tourist destinations in developing countries where tourism is adopted as a means of the economic development (Oppermann and Chon, 1997; Telfer and Sharpley, 2008).

2.2. Data collection methods

Firstly, existing documents published by Saensuk municipality were investigated to understand how the municipality allocated their budget for MSWM activities. Documents were obtained from the municipality. Information was collected from 2003 to 2010 because of its availability in the municipality records. Secondly, in-depth interviews were conducted with 84 stakeholders from August, 2010 to March, 2011. The researchers chose 84 interviewees because information was saturated. The stakeholders were divided into three groups: municipality officials, locals and tourists. A purposive sampling method was employed to select 11 interviewees. The first group was comprised of the Mayor, town councilors, municipality officers, and waste workers. This method was employed because informants who hold technical and detail information on MSWM in Bang Saen were limited to this group. A snowball sampling method was employed to select interviewees in the second group with a sample size of 64, which included beach vendors, restaurateurs, hoteliers, proprietors of convenience stores and owners of other businesses, formal and informal recyclers, and householders. This method was selected, because it is useful to find people who have an interest in maintenance and cleanliness of the town, especially those who are engaged in tourism. Open-ended questions were asked to collect information on how activities related to MSWM affected interviewees' daily life. Lastly, simple random sampling was employed to select interviewees in the third group of 9 who were day trippers and overnight visitors. The researchers followed a certain route in Bang Saen and asked every fifth group the researchers passed through to cooperate to the interview to improve randomness (Veal, 2006). Open-ended questions were asked to derive information on activities related to MSWM during holiday in Bang Saen. Thirdly, non-participant observation on MSWM of waste workers was carried out and notes and pictures were taken to collect information on their actual work

on MSW collection, transportation and disposal.

2.3. Data analysis methods

Firstly, budget used for activities related to MSWM between 2003 and 2010 was measured. Usage was classified according to the definitions shown in Table 1 as follows: financial capital contained fuel expenses, personnel expenses, and maintenance costs of vehicles, machines and equipments. Manufactured capital was made up of purchase of garbage trucks, sweeper trucks, landfill compactors, rubbish bins and cleaning equipments. Human capital involved the costs of medical examinations and capacity building for municipality officials. Social capital covered organizing cleanup activities, supporting volunteers and raising environmental awareness to foster cooperation. Natural capital embodied expenses of supporting waste recycling to improve natural resource depletion. Secondly, content analysis of qualitative data obtained from in-depth interviews was conducted by summarizing how each type of capital supported activities of the stakeholders related to MSWM and how these activities generated output. Furthermore, output, which was created by activities of the stakeholders, to five capitals in monetary value was estimated. Output in terms of financial capital was estimated by calculating opportunity cost. Firstly, the average per ton cost of MSWM in Thailand was calculated. Data was obtained from Suttibak and Nitivattananon (2006), which showed per ton cost of MSWM in twenty municipalities in every region of the country including *Nakhon* (city), *Mueang* (town) and *Tambon* (sub-district municipality). Secondly, the cost was multiplied by the amount of MSW generated in Bang Saen every year. Yield of manufactured capital was estimated by calculating depreciation expenses per year based on accounting standards in Thailand, and a straight-line depreciation method was employed for the calculation. Output of human capital was estimated by calculating the total number of absences from work on account of illnesses. Yield of social capital was

estimated by using daily wages of waste workers that the municipality can save through expanding volunteer work and raising environmental awareness. Last, output of natural capital was estimated by measuring profits of recyclables sold to recyclable waste bank (RWB) in communities. Thirdly, data obtained from non-participant observation was analyzed by summarizing how waste workers conducted MSW collection, transportation and disposal.

3. Results and Discussions

3.1. Input to five capitals

Saensuk municipality has two main revenue sources: the central and provincial government and local people. The municipality annually received about 199.2 million baht of total budget between 2003 and 2010. Approximately 73.0 per cent of the revenue was obtained from the central and provincial government and the remainder was from locals. They annually allocated around 39.4 million baht, 20.0 per cent of total budget, to activities related to MSWM. The budget was distributed to activities related to financial, manufactured, human, social and natural capital (Table 2). Based on the results in Table 2, input to five capitals was divided into two distinct periods, that of the municipality in the first period (2003-2006) and the municipality in the second period (2007 to 2010).

Annually, about 49.2 million baht was allocated along the “five capitals” for MSWM activities in the first period. Almost 17.9 million baht, 38.4 per cent, to financial capital were spent, such as fuel expenses, personnel expenses, and maintenance costs of vehicles and machines. In addition about 27.1 million baht, 52.5 per cent, was distributed to manufactured capital, for example purchase of garbage trucks and boats, sweeper trucks, landfill compactors, rubbish bins and cleaning tools. He also yearly allocated around 0.2 million baht, 0.5 per cent, for human capital, such as health check of waste workers and training for street cleaners.

Table 2. Input to Five Capitals of Saensuk MSWM from 2003 to 2010 (in Thai baht)

| Year | Financial | Manufactured | Human | Social | Natural | Total |
|------|------------|--------------|---------|-----------|---------|------------|
| 2003 | 17,620,464 | 20,381,000 | 127,000 | 3,780,000 | 5,000 | 41,913,464 |
| 2004 | 19,956,069 | 50,630,500 | 127,000 | 3,785,000 | 5,000 | 74,503,569 |
| 2005 | 19,691,674 | 16,010,000 | 164,000 | 3,970,000 | 180,000 | 40,015,674 |
| 2006 | 14,231,484 | 21,510,000 | 364,000 | 3,890,000 | 230,000 | 40,225,484 |
| 2007 | 14,717,394 | 100,000 | 264,000 | 1,000,000 | 50,000 | 16,131,394 |
| 2008 | 16,190,314 | 4,950,000 | 264,000 | 1,350,000 | 0 | 22,754,314 |
| 2009 | 15,046,943 | 41,480,000 | 84,000 | 1,480,000 | 210,000 | 58,300,943 |
| 2010 | 20,375,228 | 0 | 30,000 | 1,140,000 | 200,000 | 21,745,228 |

Furthermore he dispensed 3.9 million baht per year, 8.4 per cent, to social capital, for example printed matters, signboards and broadcasting for raising environmental awareness. Finally, nearly 0.1 million baht was used per annum, 0.3 per cent, for natural capital, such as supporting the RWB in communities through purchase of equipment.

On the other hand, around 29.7 million baht was distributed in the second period to five capitals for activities related to MSWM, which was a decrease of about 39.6 per cent compared to the first period. This was because the second period did not acquire a special purpose budget for the purchase of vehicles and equipments. Around 16.6 million baht was used, 70.5 per cent, for financial capital. In addition, about 11.6 million baht was spent, 23.4 per cent, to manufactured capital. Almost 0.2 million baht was used, 0.8 per cent, for human capital. Furthermore, nearly 1.2 million baht was spent, 5.0 per cent, for social capital, such as organizing educational programs and cleanup activities. Finally, 0.1 million baht was used, 0.4 per cent, for natural capital.

While the municipality in the first period yearly distributed about 44.8 million baht, 90.9 per cent, to financial and manufactured capitals; the second period spent 28.2 million baht, 93.9 per cent, to these capitals. The first period allocated 4.4 million baht per annum, 9.1 per cent, to human, social and natural capitals. On the other hand, the second period spent 1.5 million baht annually, 6.2 per cent, on these capitals. Based on these expenditures, decision making of the municipality in both periods was not influenced by assessments of output, which stemmed from the nonexistence of policy on MSWM (Saensuk municipality, 2003, 2004, 2005, 2006, 2007, 2008, 2009, and 2010a). This implies that if capital is allocated without a well-defined goal, expenditures will fluctuate every year along the five types of capital. Hence, the municipality should create a clear policy goal related to MSWM.

3.2. Activities of stakeholders supported by each capital

Financial capital, specifically personnel expenses, fuel expenses and maintenance costs of vehicles, machines and equipments, gave support to the municipality to carry out activities related to MSWM - collection, transportation and disposal of MSW. In both periods, the municipality employed 49 garbage men and divided them into 13 teams and each team collected MSW from their assigned route once a day. Furthermore they assigned 2 garbage men to collect marine debris caught in rubbish traps by boat once a week. However, there is a 5 kilometer long net in place that prevents marine

debris from drifting ashore on the beaches. Head of Public Health Division (PHD) revealed that about 60.0 per cent of debris can be caught by this device. The municipality also employed 52 street cleaners and assigned them to clean the streets, mow grass and wash rubbish bins in their area of responsibility. Finally all MSW was transported to the municipality's sanitary landfill site, which located in Bang Phra Sub-district, around 21 kilometers from Bang Saen. They employed 9 landfill workers to manage site activities, such as landfill, dispersion of effective microorganisms (EM), and addition of EM into leachate from the landfill. In both periods, financial capital was primarily allocated to daily MSW collection, transportation and disposal. The number of workers appears sufficient as they collect 100 per cent of community waste and transport it to the landfill daily. Head of PHD and Sanitary Engineering Division (SED) confirmed that there has never been an assessment of the daily collection, transportation and disposal of MSW. This implies that capital input was made without accounting for the efficacy of this approach.

From the above activities, capital allocation should be maintained consistently every year at a level that can address MSWM properly. Moreover from field observations, workers tried to collect recyclables during their work activities. All workers reported that collecting recyclables was for earning extra income and they made an extra 100 baht per day from this activity. However, collecting recyclables reduced labor effectiveness as they spent more time going after recyclables than MSW. Workers' wages were equivalent to the minimum wage per day in Chonburi Province (196 baht, as of 2010), and therefore their wages potentially increased by more than 100 baht and collecting recyclables during working hours needs to be prohibited (Sasaki, 2004). Hence, fuel expenses can be reduced by saving the amount of time vehicles are used during work.

Manufactured capital, which covers the purchase of garbage trucks and boats, sweeper trucks, landfill compactors, rubbish bins, cleaning tools and new nets as rubbish traps, were effective tools for the municipality to improve collection, transportation and disposal of MSW. In the first period, the municipality provided garbage men with 10 new garbage trucks, and 2 new boats to collect MSW from the communities and coastline. These vehicles were indispensable for daily collection and transportation of MSW. They also supplied 1 sweeper truck and additional cleaning tools to street cleaners. Those trucks and tools supported them to clean up the streets of litter and dead leaves, and maintain the cleanliness of the town. Moreover, they provided landfill workers with 1 landfill compactor. It was expected that this compactor would help the

workers to handle and landfill MSW efficiently onsite. In both periods, the municipality tried to keep approximately 2,000 wheelie bins in total in the entire town and replaced worn-out bins with new ones. These bins helped to support locals and tourists in the disposal of MSW. The trucks, boats, compactors and rubbish bins purchased in the first period were inherited in the second period. The municipality in the second period purchased 2 garbage trucks and a new net as a rubbish trap in 2008 and 2009, respectively. Manufactured capital was essentially geared toward continuing this routine maintaining the cleanliness of the town on a daily basis.

This trend was further expedited by municipality officials who believed that purchasing the latest vehicles was the sole means to improve MSWM. This stemmed from the lack of a holistic view on MSWM among the decision makers. Purchase of more advanced technology alone cannot improve MSWM, because this is symptom-oriented approach that addresses waste problems downstream, not at the source of the problem. Therefore, this type of capital allocation needs to be consistent because purchasing vehicles alone cannot improve total output.

Human capital, especially health checks and training supported waste workers' health and improved cleaning skills. In both periods, the municipality employed medical doctors to conduct a health examination of workers once a year and supplied them with first aid kits. The Head of PHD and SED confirmed that health checks are important to secure the workforce carrying out present-day MSWM tasks. From field observations, workers were found not wearing protective gear (e.g. gloves, work shoes, and clothes) and they used machines improperly. For example they stood at the chute of the garbage truck and helped load MSW into the truck without the use of personal protective equipments. The municipality in the second period provided street cleaners with a program on how to clean public spaces. From interviews, both division heads reported that they only know how to collect, transport and dispose MSW but they did not know how to improve the efficiency of MSWM. That is the reason why they prone to continue managing MSW in business-as-usual manner. Improvement in this area cannot be expected without setting a goal of human resource development for the municipality officers.

Hence, capital should be allocated towards capacity building of workers to ensure that they know how to collect, transport and dispose of MSW properly and safely and understand the potential risks associated with handling MSW (UN-HABITAT, 2010). As a result, the life expectancy of vehicles, machines and equipments can be extended, maintenance costs of these can be

reduced, and absence from work on account of illness can be improved. Secondly, capital allocation to developing the administration skills officers is of the utmost importance, because the lack of qualified human resources has contributed to the inability to improve the efficiency (e.g. drafting policy and plans for effective MSWM) (JICA, 2005; Hongyon, 2007). The municipality should send the officers to training programs provided by universities and government agencies, or organize study tours to learn about MSWM in other cities.

Social capital was used to raise environmental awareness of locals and tourists through various media, such as printed matter, signboards, broadcasting, organizing educational programs and voluntary cleanup activities. The municipality in the first period primarily used printed matter, signboards and broadcasting to ask locals and tourists to cooperate in the separation of MSW and help to maintain the cleanliness of the beaches. The municipality in the second period organized educational programs that targeted 200 beach vendors. These programs also promoted cleanup activities to encourage locals and tourists to cooperate in keeping the beaches clean. However, the attempts of the municipality in both periods failed to raise people's awareness. Almost 62.8 per cent of locals tended to leave MSW unseparated for those who wanted to earn extra income by collecting recyclables. Locals even believed that they were doing a good thing as their actions generated income for the poor. Nearly 93.8 per cent of locals' attitude to the municipality was that they must maintain the cleanliness of public area. And they participated in MSW activities because they were afraid of being marked by municipal officers owing to non-participation and consequently having their business license is confiscated by officers. Thai tourists' attitudes were also similar to the locals. Despite the installation of signboards, tourists never cared about keeping the beaches clean. Approximately 75.0 per cent of tourists stated that cleaning up the place they holiday at is not their responsibility. They also reported that the locals should be responsible as they earn incomes from selling tourism products and services at the beaches.

The improvement of MSWM requires active cooperation from all stakeholders. However, the lack of awareness that the stakeholders have a stake in maintenance of the cleanliness of the whole town prevents them from fostering cooperation (Joseph, 2006). The lack of awareness stemmed from supporting improper activities; however it is difficult to support proper activities if there is no feedback or lesson learnt from their allocation. The situation can be improved by programs that focus on raising the awareness of all stakeholders. Informal educational programs that

target all key stakeholders, such as beach vendors, restaurateurs, hoteliers, proprietors of convenience stores can be organized and the waste hierarchy comprised of key subject areas (i.e. waste prevention, reuse, recycling, recovery and disposal) to improve knowledge, attitude and practice (European Waste Framework Directive, 2008; U.S. EPA, 2012). As for other stakeholders, especially householders, information should be disseminated through public relations magazine and local radio programs to encourage them to cooperate in the maintenance of the environment (Jones, 2006). Forming social networks to collectively address these problems should be encouraged (Juhola and Westerhoff, 2011). For example, they can support NPOs and educational institutions (e.g. elementary, middle and high schools and university in Bang Saen) to provide environmental education programs with students and encourage companies to launch corporate social responsibility (CSR) activities in Bang Saen. Moreover, communication with tourists should be more direct. The municipality can ask the cooperation of beach vendors to disseminate information that encourages responsible behavior of tourists, which contributes to creating pleasant holiday experience in Bang Saen (Mehmetoglu, 2009).

Natural capital, particularly RWB, provided opportunities for people to sell recyclables and earn extra income. In both periods, this activity was relatively unsuccessful because it was mostly carried out by those who wanted extra income, such as waste workers, housekeepers, shopkeepers and waiters/waitresses. None of them sold recyclables to RWB, but directly sold to itinerant waste buyers and middlemen in the waste recycling trade, because they bought recyclables at a higher price and the RWB opened on an irregular schedule. Recycling MSW can considerably reduce the amount of MSW that needs to be collected, transported and disposed of, and therefore it can extend life expectancy of the landfill (Medina, 1999). Moreover recycling MSW can help to reduce municipality budgets. Middle-men in the waste recycling trade reported that recyclables annually generated in Bang Saen are

equivalent to more than 50 million baht.

Capital should be allocated to maximize recycling by setting up various programs. Although the municipality has no data on composition of MSW in Bang Saen, the head of PHD estimated that 70.0 per cent of MSW was generated from organic waste, which is approximately 47 tons a day. Organic waste (e.g. food and yard waste) from markets, hotels, restaurants, beach vendors, school cafeterias, and households can be collected and organic fertilizer can be produced and exchange it with for example, eggs or electric appliances or food, however it is dependent on need of the stakeholders in Bang Saen. Exchange programs can be an incentive for them to separate MSW at the source, and the municipality can sell the fertilizer in markets (Mongkolnchaiarunya, 2005; Praiswan, 2012; Irazabal, 2005).

3.3. Output to five capitals

Activities of the stakeholders related to MSWM created output to financial, manufactured, and social capitals. Output to each type of capital per year between 2003 and 2010 was estimated in monetary value (Table 3). The activities generated an average total output of 22.6 million baht per annum.

In the first period, around 20.2 million baht of total output was created per annum. Bang Saen generated about 22,350 ton of MSW per year in this period (average per ton cost of MSWM in Thailand was 638 baht). The municipality in the first period created an opportunity cost of about 14.3 million baht per year, which accounts for 70.8 per cent of total output. The cost was less than input to five capitals. Therefore, MSWM of the municipality was inefficient, and they had better ask others (e.g. the private sector) to manage MSW. Yield to manufactured capital was approximately 4.0 million baht per year, 19.8 per cent of total output. The researchers calculated this sum based on a 10 years depreciation in vehicles and machines (as reported by the head of PHD and SED). Output to human capital was unavailable as the municipality did

Table 3. Outputs to Five Capitals of Saensuk MSWM from 2003 to 2010 (in Thai baht)

| Year | Financial | Manufactured | Human | Social | Natural | Total |
|------|------------|--------------|-------|-----------|---------|------------|
| 2003 | 13,806,862 | 1,618,100 | n.a. | 2,025,000 | 0 | 17,449,962 |
| 2004 | 14,107,264 | 2,973,100 | n.a. | 1,910,500 | 0 | 18,990,864 |
| 2005 | 14,407,666 | 4,573,100 | n.a. | 1,798,000 | 0 | 20,778,766 |
| 2006 | 14,717,384 | 6,723,100 | n.a. | 2,090,500 | 0 | 23,530,984 |
| 2007 | 15,804,886 | 6,723,100 | n.a. | 1,980,000 | 0 | 24,507,986 |
| 2008 | 16,619,931 | 7,127,600 | n.a. | 1,575,000 | 0 | 25,322,531 |
| 2009 | 16,966,908 | 7,127,600 | n.a. | 1,573,000 | 0 | 25,667,508 |
| 2010 | 17,616,615 | 7,127,600 | n.a. | 110,500 | 0 | 24,854,715 |

Remarks: n.a. – not available

not keep records regarding the absence rates on account of illness. The municipality yielded output to social capital as volunteers helped clean up the beaches and town. They yearly saved labor costs of waste workers equivalent to almost 1.9 million baht, 9.4 per cent of total output. They did not acquire any output to natural capital as no one came to sell recyclables.

In the second period, around 25.1 million baht of total output was created yearly. Bang Saen generated 26,257 ton of MSW per year in this period. The municipality in the second period created opportunity costs at about 16.8 million baht per year, 66.9 per cent of total output. The cost was less than total input to five capitals. Consequently, MSWM of the municipality was inefficient, and similar to previous periods. Yield to manufactured capital was nearly 7.0 million baht per year, 27.9 per cent of total output. Output to human capital was still unavailable. The municipality made output to social capital as volunteers participated in beach and town cleanup and saved personnel expenses of workers equivalent to nearly 1.3 million baht, 5.2 per cent of total output. Output to this capital was reduced 31.6 per cent in his period. As in the previous period, they did not receive output from natural capital as no one sold recyclables.

While the municipality in the first period generated around 20.2 million baht of total output from financial, manufactured, and social capital, the second period produced nearly 25.1 million baht. The municipality in the second period created more output than the first period, difference of 4.9 million baht. However, this does not signify that capital allocation was better in the second period than the first period as 70.3 per cent of locals voiced that Bang Saen was cleaner in the first period. Although the performance of stakeholders can improve total output, which therefore improves the long-term sustainability of the MSWM system, mistake that the municipality in both periods made was an

absence of assessments of output produced by the activities of the stakeholders related to MSWM that they were supporting. There were few lessons learnt from past experiences, and therefore they tended to keep making the same mistakes. Making assessments of all MSWM activities that the municipality supports is significant because they can readjust input and reflect feedback in decision making on capital allocation.

4. Conclusions

Zero-waste as an output of the MSWM system could be possible in Bang Saen if all stakeholders take their responsibilities seriously and perform them with proper support from the five capitals. This research showed that total output from the five capitals is influenced by the performance of stakeholders, which is dependent on input from the five capitals. However, input was made without assessments of outcomes created by the activities of the stakeholders, which stemmed from the absence of a policy goal on MSWM and short and long-term action plans for capital allocation on the activities required to achieve their goals. Capital allocation without policy goal and its action plans made input inconsistent every year. Capital was mostly allocated to financial and manufactured capital to support MSW collection, transportation and disposal. Capital should be allocated to human, social and natural capitals, such as training, environmental awareness raising of stakeholders, reuse, recycling and recovery of MSW, which can help improve activity performance of the stakeholders, and therefore improve total output and sustainability of the system. In Fig. 1, input and output in both periods are compared. Input was relatively more than output in the first period, but input was generally less than output in the the second period. However, this output stemmed from budgetary cutbacks on MSWM rather than a dramatic improvement

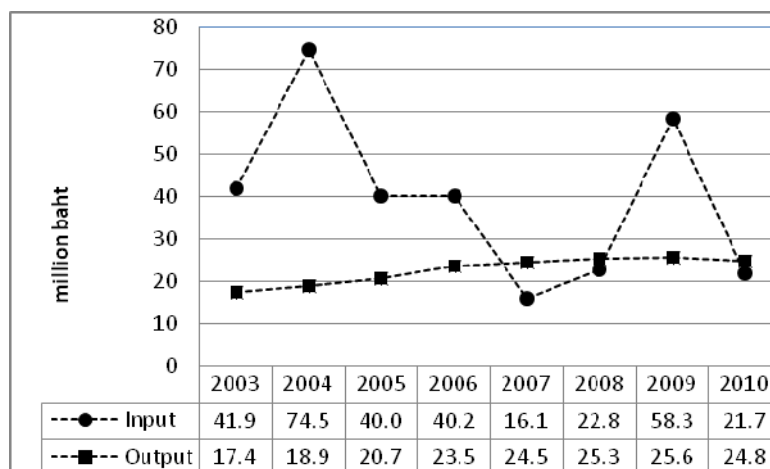


Figure 1. Comparison of Total Input and Total Output of MSWM between 2003 and 2010

in the performance of the stakeholders, because output was relatively fixed while input is fluctuated. This signifies that whatever amount of budget is input, output remain almost the same. Although MSWM is a non-profit public service, maintaining input at a level less than output is preferable to make the system more sustainable. Well-designed activities can be created by readjusting input based on assessments of output and by reflecting on feedback from decision making on capital allocation; otherwise they mistakes will be repeated.

Recommendation is given to the municipality on the most popular tourist destination in Thailand. Decision makers in the municipality should allocate budget to each capital in proportion to the MSWM system under a clear policy of environmental management with implementation plans. On the average, the municipality has allocated 54.41, 37.95, 0.61, 6.70 and 0.3 per cent of capital to financial, manufactured, human, social and natural capital, respectively. These proportions are improper as unsatisfied output was created. Consequently, capital allocation to financial and manufactured capitals should be reduced to 40.0 and 25.0 per cent, respectively. And capital allocation to human, social and natural capitals should be increased to 5.0, 20.0 and 10.0 per cent, respectively. This is based on the assumption that about 39 million baht is allocated on the average to activities related to MSWM, the proportion to financial, manufactured, human, social and natural capitals will be 15.6, 9.75, 1.95, 7.8 and 3.9 million baht, respectively. This will be adequate for the continuation of collection, transportation, and daily disposal of waste as discussed in terms of human, social and natural capital. However, the proportion should be readjusted annually according to assessments on the output made by the activities of all stakeholders, which should be reflected upon in terms of making better performance, and therefore increasing total output which improves the sustainability of the system.

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