

EFFECTIVENESS OF IMPLEMENTING WASTE BANK OPERATION ON SOLID WASTE MINIMIZATION IN KUNDASANG, SABAH, MALAYSIA

FATMA SABARIAH ALIAS

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By

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, In Fulfilment of the Requirement for the Degree of Doctor of Philosophy

October 2018

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

EFFECTIVENESS OF IMPLEMENTING WASTE BANK OPERATION ON SOLID WASTE MINIMIZATION IN KUNDASANG, SABAH, MALAYSIA

By

FATMA SABARIAH BINTI ALIAS

October 2018

Chairman: Associate Professor Latifah Abd Manaf, PhDFaculty: Environmental Studies

Modernization and urbanization has changing the ways how Malaysian live, think and act. With the rapid changing culture, Malaysians produce more waste than before. Nowadays, 38,000 tonnes of waste was produce per day in Malaysia which reached 12.8 million tonnes of waste generated per year. These striking figure has become a major problem to the country due to the latest figure has exceeded the government's projected waste production in year 2020 which is 30,000 tonnes per day. Therefore, the government attempts to increase the national recycling rates from the current 17.5% to at least 22% by year 2020. However, the contributions of household were crucial in minimizing solid waste generation effectively by recycling practices. Thus, this study investigated the effectiveness of solid waste minimization through the implementation of waste bank operation in Kundasang, Sabah. Waste bank were operated to engage and empowering the communities in recycling practices and creating a sense of citizen role in environmental awareness. Hence, a pre and post survey was conducted before and after the implementation of waste bank operation. Results from the pre survey, revealed about 41% of respondents dispose their waste by burning due to none solid waste collection services by local authority which resulting the respondents dispose their waste improperly, thus contributing to the solid waste problem in Kundasang. Subsequently, about 65.7% of respondents didn't separate their waste because of no time (35.7%), no recycling facilities (21.7%), do not know how to separate (4.7%) and feel laziness (3.7%) in practicing solid waste separation at household. Additionally, due to higher tourism activities at Kundasang have worsened the scenario. As recycling practices effective in minimizing the solid waste generation, thus waste bank operation were proposed to be implemented at Kundasang town. However, about 61% of respondents willing to participate in the waste bank operation where almost all range age from 19 years below until 60 years old were interested. Besides that, the pre survey revealed about 63% of respondents was willing to participate in the waste bank because of incentives provided. Nonetheless, incentives were provided as the supporting factor to motivate the community participate in the waste bank operation.

Thus, during the 6 months of waste bank operation, there are about 53 participants were registered as the waste bank member where the members brings their recyclables waste to be sort, weight and recorded. About 2501.30 kg recyclables waste were collected in two-phase which are in phase 1 operated in July until October 2016 and phase 2 from January until March 2017. The highest recyclables waste collection were dominance by 1114.50 kg of paper, then followed with 672.20 kg of box/cardboard, 258.30 kg of plastic, 102.45 kg of aluminum cans, 231.40 kg of metal and 122.45 kg of glass with total waste bank revenue has achieved RM 599.44. The waste bank has been successfully operated as the results from the post survey shows the positive changes in respondent's awareness as an increasing in solid waste separation (47.3% respondents). Moreover, positive changes in respondent's attitude occurred in the reduction of 18% from the pre-survey results in solid waste disposal which only 23% of respondents dispose their waste improperly. On the other hand, although 66% of the respondents know the waste bank operation, but only 17.7% were took action by participate in the waste bank. The main reason were due to do not get any information (16.3 %), less publicity (12.7%), location of the waste bank (4.7%), and others (0.3%) do not collect recyclables which had influenced the number of participation in the waste bank. Although the recycling rate for the respondents was still low as 0.26 kg/person/day but the implementation of waste bank has create a positive impacts to the Kundasang community which enhancing the potential of waste bank as the accessible and convenience recyclables collection at the community level and the opportunity in generating additional income. Furthermore, the implementation of waste bank operation has revealed its effectiveness as the net benefits were highly positive as calculated RM 14,583.28 which overweighs the costs of waste bank operation. The benefits and costs also indicate that the waste bank operation was a feasibility project where the collection effectiveness reached 17.7% with potential diversion rate was 17.7%. In the nutshell, the implementation of the waste bank operation brought benefits to the community by empower and engage the local community into the planning and management of solid waste minimization especially in recycling practices within their own neighborhood where the intention was to encourage and increase the awareness among the community especially in the rural and small communities.

Keywords: recyclables waste, waste bank, recycling, community, economic benefit

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

KEBERKESANAN PELAKSANAAN OPERASI BANK SAMPAH DALAM PENGURANGAN SISA PEPEJAL DI KUNDASANG, SABAH, MALAYSIA

Oleh

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Pengerusi Fakulti

: Profesor Madya Latifah Abd Manaf, PhD : Pengajian Alam Sekitar

Pemodenan dan perbandaran telah mengubah masyarakat Malaysia di dalam cara hidup, berfikir dan tingkah laku. Dengan kepesatan budaya yang semakin pesat membangun, rakyat Malaysia telah menghasilkan lebih banyak sisa daripada sebelumnya. Pada masa kini, 38,000 tan sisa telah dihasilkan setiap hari di Malaysia di mana penjanaan sisa sebanyak 12.8 tan dihasilkan setiap tahun. Peningkatan angka ini menjadi satu masalah utama di dalam Negara kerana amaun sisa yang dihasilkan telah melampaui penjanaan sisa yang diunjurkan oleh kerajaan pada tahun 2020 iaitu 30,000 tan sisa setiap hari. Oleh itu, kerajaan telah merancang untuk meningkatkan kadar kitar semula kebangsaan dari 17.5% pada masa sekarang kepada sekurang-kurangnya 22% menjelang tahun 2020. Walaubagaimanapun, sumbangan isi rumah adalah penting dalam meminimumkan penjanaan sisa pepejal dengan berkesan melalui amalan kitar semula. Oleh itu, kajian ini menyiasat tahap keberkesanan pengurangan sisa pepejal melalui operasi bank sampah di Kundasang. Bank sampah dikendalikan untuk melibatkan dan memperkasakan komuniti di dalam amalan kitar semula dan mewujudkan peranan komuniti dalam kesedaran terhadap alam sekitar. Untuk memenuhi objektif kajian ini, kaji selidik pra dan pasca tinjauan telah dijalankan sebelum dan selepas pelaksanaan operasi bank sampah. Hasil keputusan pra tinjaun mendedahkan kira-kira 41% responden membuang sampah mereka dengan membakar disebabkan tiada perkhidmatan pengumpulan sisa pepejal oleh pihak berkuasa tempatan yang mengakibatkan responden membuang sampah mereka dengan tidak betul, sehingga menyumbang kepada masalah sisa pepejal di Kundasang. Seterusnya, kira-kira 65.7% responden tidak mengasingkan sisa pepejal mereka kerana kekurangan masa ((35.7%), tiada kemudahan kitar semula (21.7%), tidak tahu bagaimana untuk mengasingkan sisa pepejal (4.7%) dan sikap malas (3.7%) dalam mempraktikkan pengasingan sisa pepejal di rumah. Di samping itu, aktiviti pelancongan yang tinggi di Kundasang semakin memburukkan lagi keadaan. Amalan kitar semula terbukti berkesan dalam meminimumkan penjanaan sisa pepejal, maka operasi bank sampah dicadangkan untuk dilaksanakan di Pekan Kundasang. Walau bagaimanapun, kira-kira 61% responden sanggup mengambil bahagian dalam operasi bank sampah di mana hampir semua umur berumur dari 19 tahun ke bawah umur sehingga 60 tahun berminat untuk menyertainya. Pra tinjauan juga mendedahkan kira-kira 63% responden sanggup mengambil bahagian di dalam operasi bank sampah kerana insentif yang disediakan. Walau bagaimanapun, insentif yang diberikan adalah sebagai faktor sokongan untuk memotivasikan masyarakat menyertai operasi bank sampah. Oleh itu, sepanjang tempoh 6 bulan operasi bank sampah dilaksanakan, terdapat kira-kira 53 peserta yang berdaftar sebagai ahli bank sampah di mana ahli membawa sisa kitar semula mereka untuk disusun, di timbang dan direkodkan. Kira-kira 2501.30 kg sisa kitar semula telah dikumpulkan di dalam dua fasa di mana fasa 1 dikendalikan pada bulan Julai hingga Oktober 2016 dan fasa 2 dari Januari hingga Mac 2017. Pengumpulan sisa kitar semula tertinggi adalah didominasi oleh 1114.50 kg kertas, diikuti dengan 672.20 kg kotak / kadbod, 258.30 kg plastik, 102.45 kg tin aluminium, 231.40 kg logam dan 122.45 kg kaca dengan jumlah penjualan telah mencapai RM 599.44. Operasi bank sampah telah berjaya dilaksanakan kerana hasil daripada pasca tinjaun menunjukkan perubahan positif di dalam kesedaran responden di mana peningkatan di dalam pengasingan sisa pepejal (47.3%). Selain itu, perubahan sikap positif juga ditunjukkan apabila terdapat pengurangan sebanyak 18% daripada hasil pra tinjauan di dalam pelupusan sisa pepejal. Sekurang-kurangnya hanya 23% responden yang masih membuang sampah mereka dengan tidak betul. Sebaliknya, walaupun terdapat 66% responden mengetahui operasi bank sampah, namun hanya 17.7% yang mengambil tindakan dengan menyertai bank sampah. Sebab utama adalah kerana tidak mendapat apa-apa maklumat (16.3%), kurang publisiti (12.7%), lokasi bank sampah (4.7%), dan lain-lain (0.3%) tidak mengumpul bahan kitar semula telah mempengaruhi bilangan penyertaan di dalam operasi bank sampah. Walaupun kadar kitar semula bagi responden masih rendah iaitu 0.26 kg / orang / hari namun pelaksanaan bank sampah telah memberi kesan positif kepada komuniti Kundasang dalam meningkatkan potensi bank sampah sebagai pusat pengumpulan kitar semula yang boleh diakses di peringkat komuniti dan peluang dalam menjana pendapatan tambahan. Selain itu, pelaksanaan operasi bank sampah telah menunjukkan keberkesanannya di mana faedah bersih sebanyak RM 14,583.28 yang melebihi kos operasi bank sampah. Analisis faedah dan kos menyimpulkan bahawa operasi bank sampah merupakan projek kebolehlaksanaan di mana kadar pengumpulan berkesan sebanyak 17.7% dan kadar peralihan sisa sebanyak 17.7% telah direkodkan. Secara ringkas, perlaksanaan bank sampah memberikan lebih banvak manfaat dalam melibatkan komuniti tempatan di dalam perancangan dan pengurangan sisa pepejal terutamanya di dalam amalan kitar semula di kawasan kejiranan mereka di mana tujuannya adalah untuk menanamkan nilai kesedaran dan penyertaan daripada komuniti terutamanya di kalangan masyarakat yang berada di luar bandar dan komuniti kecil.

Kata kunci: sisa kitar semula, bank sampah, kitar semula, komuniti, pendapatan sampingan

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

Latifah Abd Manaf, PhD

Associate Professor Faculty of Environmental Studies Universiti Putra Malaysia (Chairman)

Sabrina Ho Abdullah, PhD

Senior Lecturer Faculty of Environmental Studies Universiti Putra Malaysia (Member)

Mariani Ariffin, PhD

Senior Lecturer Faculty of Environmental Studies Universiti Putra Malaysia (Member)

ROBIAH BINTI YUNUS, PhD Professor and Dean School of Graduate Studies Universiti Putra Malaysia

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Signature Name of O Superviso Committe	: Chairman of ry e:	Μ	4
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LIST OF ABBREVIATIONS

MSW	Municipal Solid Waste
NSWMD	National Solid Waste Management Department
LA	Local Authority
JKDB	Jawatankuasa Kemajuan Dalam Bandar
KBI	Kundasang Organization
LGO	Local Government Ordinance



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CHAPTER 1

INTRODUCTION

1.1 Introduction

The world is now drastically changing era with the deepening in economic globalization and emerging technologies. The transformation has resulted the solid waste become an important issues all over the world as globalization and population increase. The facts which illustrate the magnitude of challenged associated with waste shouldn't be overlooked. Every year an estimated 1.3 billion tonnes of solid waste is collected worldwide. The quantity of solid waste is expected to reach 2.2 billion tonnes per year by year 2025 with almost all of the increasing were from developing countries (Hoornweg and Bhada-Tata, 2012).

Malaysia not excluded in this transformation era. Currently, Malaysia is witnessing the convergence of traditional society with modernization. This broad transformation is changing the ways how Malaysian life, think and act. The rapid development in Malaysia with total population approximately 29.2 million accelerate the daily generation in volume of solid waste which 30,000 tonnes was produce in year 2012. Respectively, 10.9 million tonnes of solid waste per year was generated, however in year 2015, solid waste generation has increased to 38,000 tonnes per day which generate 12.8 million tonnes of solid waste which predicted 15.6 million tonnes of solid waste in year 2020 (Agamuthu and Dennis, 2011; SWCorp, 2014, Harian Metro, 2016). Deputy Urban Wellbeing, Housing and Local Government Minister Datuk Halimah Mohd Sadique said the ministry viewed this as a major problem due to the latest figure exceeded the government's projected waste production of 30,000 tonnes daily by year 2020. The striking fact shows how Malaysians generates more waste continuously. The tremendous trend on the increasing of solid waste generation led to the potential threat to the environment, society and economic losses as the dependence on the landfill as the main disposal method which particularly causing a serious environmental problems such as soil contamination, leachate, gas emission, and air pollution (Shekdar, 2009; Fauziah et al, 2007; Agamuthu and Fauziah, 2011).

Despite its negative impacts to the environment, solid waste which always been seen as dirty, neglected and not useful should be seen as positive and inherently valuable combination of material that can be processed with specific purpose (Connett and Sheehan, 2011). With the increasing pressure on the amount of waste generated, moves have to be taken to reduce, divert and recover materials as solid waste could create a large opportunity and benefits to the local authority, society and individual respectively. Proper solid waste management present an opportunity not only to avoid the detrimental impacts associated with waste but it can recover resources, environment, economic, social benefits which towards to the sustainable future.

1.2 Problem Statement

Solid waste has become the most common issues in the developing countries, in every city, as piles of waste were littered at the streets, drains, back lanes, and walkways in every residential area in rural and urban area. Looking at the fact that, householders as the main generator who primarily the highest producer of waste were still lacking in managing their waste properly and efficiently. The rising of solid waste generation has create burden to the solid waste disposal sites as currently Malaysia practicing landfill as the main disposal of waste where approximately 89% of waste was collected is taken to the landfill sites (MHLG, 2011). The problem rise as the heavy reliance on landfill has caused a significant problems of space limitations, health and environmental issues to the country.

Recent years, solid waste minimization strategies particularly in recycling has seem to be noticed as a solution in reducing the solid waste generation. Thus, the Malaysian government has taken initiative by force the Solid Waste Management and Public Cleansing Act 2007 (Act 672) by mandatory of solid waste separation at source in September 2015 in order to reduce the solid waste generation at the disposal site and encourage solid waste separation at source among the householders. However, Malaysian still sporadic and sceptical on the beneficial of recycling practices as the current recycling rate in Malaysia was 17.5% in 2016 which still far for the target of 22% by year 2020 (JPSPN, 2017). Former Solid Waste Corporation (SWCorp) Chief Executive Officer Datuk Ab Rahim Md Noor has stated that the recycling rate were still lower compared to other developed countries which have reached more than 40% such as Singapore 59%, Korea 49%, Taiwan 60% and developing countries within Asia where recycling rate about 30% to 47% (SWCorp, 2014; Mahmud and Osman, 2010).

The common issues were included in Kundasang as its location in the remote area causing the waste issues become worse particularly due to the high tourism activities. Kundasang has been known as the most visited place by tourist from all over the world. The high concentrations of tourist activities with appealing nature attractions, waste disposal could become a serious problem and improper waste disposal lead to a major despoiler to the environment, sociocultural, and economics as well (Muchapondwa and Stage, 2013; Norjanah et al, 2014). Moreover, non regular waste collection services from the local authority especially in the residential areas make the situational worsen as it didn't include in their jurisdiction area. The impacts of solid waste due to tourism activities threaten the disturbance to the local community and to the local authority.

Moreover, there are still lacking in solid waste management handled in Kundasang. The remarkable incompetence regarding solid waste issues in Kundasang can be seen clearly on the waste collection site as lack of solid waste management and facilities results the negative impact to the community and create pressure to the tourism activities (Jaafar et al, 2015). The storage of solid waste in residential areas is remarkably low since insufficient waste storage provided by local authority. For that

reason, the community tend to burn the solid waste and dispose at illegal dumping site, hence cause air pollution and disturbance of rodents and flies. As well as the collected waste were directly transported to the open dumping landfill at Tanah Merah, Ranau without remarkable proper treatment for leachate and gas emission.

Waste bank is a concept and place to sort and collection of recyclables waste that have economic values by involving the community as the solution for the waste problem (Hasfarm et al, 2014; Dhokhikah et al, 2015). This waste bank concept has been widely applied all over the world with different brand name such as Community Based Waste Bank (CBWB), *Bank Sampah*, Solid Waste (SW) bank or recycling bank however it different with the informal sectors such as waste pickers, scavengers and itinerant buyers. Waste bank aims to disseminate 3R concept and train the community at the level of solid waste separation, collection and recycling (Wilson et al, 2006; Raharjo et al, 2017). Besides that, waste bank also contributes in solving the solid waste management problem especially in the developing country.

The advantages of waste bank operation focused on the community awareness on environmental problem to reduce the solid waste generation for the long term and change the community behaviour. The development of waste bank also contributes on the economical benefit and improves the quality of life as well (Raharjo et al, 2017). Waste bank operations are community belief to encourage the community to do waste separation and recycling at sources especially at household. While Singhirunnusorn et al, (2012), mentioned that waste bank aimed to involve the entire community by creating a sense of citizen role to solve the environmental problem in the community. This is due to the major obstacles to the solid waste management problem includes non-involvement of the stakeholders in planning and decision making and a weak coordination between the local authorities with the local communities (Pasang et al, 2007; Raharjo et al, 2017).

1.3 Research Objectives

The main objective is to study the effectiveness on solid waste minimization through the implementation of waste bank operation in Kundasang, Sabah.

The objectives of this study are:

- 1. to determine the community willingness to participate in waste bank operation in Kundasang, Sabah.
- 2. to measure the recyclables waste collection during the waste bank operation for 6 months in Kundasang, Sabah.
- 3. to examine the community participation and waste bank member satisfaction in waste bank operation in Kundasang, Sabah.

4. to evaluate the economic aspect of waste bank operation through benefit-cost analysis in Kundasang, Sabah.

1.4 Research Questions

In line with the objective, this study seeks to investigate the following research questions:

- i. Are the community were willing to participate in the waste bank operation?
- ii. How much the total recyclables waste collected during the waste bank operation?
- iii. Does the community participant and satisfied with the waste bank operation?
- iv. Does the implementation of waste bank operation were beneficial in economic aspect?

1.5 Scope of Studies

Basically, this research attempts to study the community's participation on solid waste recycling practices through the implementation of waste bank operation in Kundasang, Sabah, based on their willingness to participate and satisfaction towards waste bank operation. There is a high potential of the implementation of waste bank especially in the rural area. The development of waste bank as the recycling facilities contributes to the community involvement in solid waste separation at source and encouraging recycling activities especially to the householder as the main waste generator. This study was conducted at Kundasang, the most visited place by tourist and main attraction in Sabah due to the location of Mount Kinabalu which is the highest mountain in Southeast Asia and the green panoramic view of mountains and vegetables farm.

However, considering the community willingness to participate in waste bank, a preliminary (pre) survey was conducted as the baseline data before the implementation of waste bank. The pre survey helps the researcher in investigate and gathering information regarding the solid waste issues in the area. This study highlights the knowledge and awareness towards solid waste separation at source and recycling practices among the household before the implementation of waste bank.

Waste bank approach was integrated in the concept of source separation, recovery of recyclables materials and collection storage. Thus, waste bank were operated in Kundasang town by engage the community in providing recyclables waste collection for 6 months. The recyclables waste would be sort, weighed and store at the waste bank. In return incentives of monetary reward were given to the community according to the price and weight for each recyclables waste. Incentives as rewards were

considered as one of the factor as an encouraging tool to collect more recyclables waste among the community as the waste bank were depends on the voluntarily bring in system. Giving rewards as appreciation to engage more people involves in the waste bank operation.

In order to examine the community participation and satisfaction in waste bank operation, a post survey was conducted in the same group as in the pre survey. It is essential in identifying the factors of participation and non participation in waste bank operation. Post survey examines the changes occur in terms of knowledge, attitudes and the acceptance of recycling facilities at the community level thus contribute to the effectiveness of the waste bank operation. The effectiveness was referred to the outcome from the pre and post survey in order to determine either the implementation of waste bank was influence the solid waste minimization.

While a benefit cost analysis were conducted to estimate the total value of costs and benefits involved in the waste bank operation. The results were importance in identify the feasibility of the programme as high benefits lead to the effectiveness of waste bank operation. Hence, it could become an exemplary of solid waste minimization programme to other local community in managing waste in a proper way thus gains economical benefit.

1.6 Significance of Studies

This study was significance to the local authority, *Majlis Daerah Ranau* (MDR) as reference, in the effectiveness in implementation of solid waste recycling facilities through waste bank operation especially in the remote area. The implementation of waste bank encourage the community to practice recycling as daily habit which contributes in reducing cost of solid waste management at the landfill site operated by local authority. Moreover, it reduces the solid waste generation to be sent to the landfill site which reduces the operational cost of landfill by the local authority.

Moreover, the findings of this study contribute to the local community awareness regarding the importance of recycling and have a proper handling of solid waste management. Within this study, it gives a wide overview to the community about solid waste issues. This research gains insights on current recycling issue such as knowledge, awareness and identifying the significant factors influencing the community to solid waste recycling behavior. With that, appropriate approaches in encouraging recycling especially in the rural area with inadequate facilities could be taken into account. It is vital to reduce the negative impacts on waste to the local community.

This study also enhances the potential of economical benefits to the rural development as its contribution from the sales of recyclables waste. In a nut shell, waste should be seen as a lucrative income both individually or society by creates opportunity in expanding their economic status respectively as well as have a green lifestyle. In fact, quadrupling recycling method was the key goal to the local government, private companies and public interest group as current method in efficient solid waste management.

1.7 Thesis Organization

Overall, this thesis consists of five chapters to assist in understanding and to follow with ease, the organization of the writing process. The chapters in this thesis have been organized as follows.

Chapter 2 will elaborate on the definition of solid waste, solid waste source, solid waste management in Malaysia, solid waste minimization approach, recycling approach and its factors influencing public to do recycling, the implementation of waste bank concept in developing country which encourage and promotes solid waste separation at source and recycling. This chapter also explicated the type of recyclables waste that can be recycled such as paper, box/cardboard, plastic, aluminium can, metal and glass. Other than that benefits of solid waste minimization also been discussed in chapter 2. Subsequently, this chapter also elaborates a literature review on various studies on recycling practices in developed and developing country.

Chapter 3 focused on the methodology of this study by focusing on data collection process, which comprises three ways in collecting data by pre survey, implementation of waste bank operation and post survey. The background of selected study area was also discussed in this chapter. Data sampling procedures and number of sample also discussed further. Type of analysis such as Paired Sample T-Test, Correlation, and Multiple Regression were used to obtain the significant p value. In addition, benefit cost analysis were conducted and explained detailed in this chapter to estimate the total benefits and total cost of the waste bank operation. To proved and strengthen the data collection procedures, a qualitative method on observations method will be elaborate as the researcher stay with the communities in 12 months period. The method will observe the participants culture, attitude and their behavior involve in the waste bank program.

While Chapter 4 represents the results and discussions of this study. The results from the pre and post study will be discussing more detail according to the objectives. In addition, the results of the study will be presented in graph and figure for reader to have clearer view about this research. An inferential analysis was conducting using the correlation between variables and analyze between pre and post survey. The results from waste bank operation were recorded as the results were used for the benefits and costs analysis. Total benefits and costs will determined the feasibility of the implementation of waste bank operation in Kundasang, Sabah.

Finally, in Chapter 5, the conclusion for this study will be discussed. Recommendation of the study also will be discussed to help further information and can give idea to

other society and other researcher to implement a waste bank in their area. The successful of waste bank operation can be an example and a good platform to the community to duplicate the system and organize a good solid waste management to the community especially in the rural and small community.



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