

A Review of Solid Waste Management in Waste Bank Activity Problems

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Abstract— This paper presents a review of solid waste management problems, with a particular focus on the household waste management through community participation in waste bank activity problems. Waste, especially solid waste is a problem that will continue to exist. Waste is generated by human's effort to fulfil their needs of life. Solid waste that continues to accumulate in the environment will cause negative impact which can interfere with human life itself. One of the example is the outbreak of a disease that lowers the level of public health. The negative impact will affect our environment, social, and economy aspect. Until now, public awareness of the importance of processing waste is still very low. This is due to several factors such as economic conditions, education, and social attitudes of the society itself. Nowadays, every country in this world try to do solid waste management because it's effect to humanity. One of the efforts to assist in the case of solid waste management is by the existence of waste bank. Waste bank is expected to be a sustainable solution to overcome the existing waste problems in the society. Society can get several benefits from waste bank because not only reduce the existing solid waste but also can improve the economic quality of the society with the payment system. The payment system is to exchange waste from society with some payments. The factors that affect the sustainability of waste banks are Awareness, knowledge, equipment, support, and infrastructure.

Keywords—community, solid waste management, sustainable, waste, waste bank

I. INTRODUCTION

Waste is a problem that we must settle as early as possible. Waste is an inevitable product of society [1]. Solid wastes consist of all the solid wastes that comes from human and animal activities and discarded as useless or unwanted [2]. The increasing production of household waste is one of the effects of population growth, rising living standards, rapid development and

urbanisation [3]. To avoid negative effect from waste, society can do waste prevention.

Waste prevention means eliminating or reducing the amount and/or the toxicity of waste, including recyclables. There are exceptions for businesses, government agencies and other organisations. Waste prevention in that fields includes processes that: conserve supplies and inventory; eliminate, reduce and reuse products and packaging; deploy waste-reducing technology and equipment; use more durable, reusable, repairable and less toxic products and packaging; leave grass clippings on the lawn to naturally decompose; and reduce food and yard waste, including through on-site composting. Waste prevention for citizens also includes: buying products with the least amount of packaging; buying only the amount of a product that is needed; buying less harmful products; and reusing, donating or repairing items that might otherwise be discarded or recycled (it can appear in the form of a garage sale) [4].

Waste management is one of the public infrastructure to provide the goods or services, and it resembles the electricity, natural gas, and water sector goods and services [5]. Waste management system usually consist some activity like collection, transportation, pre-treatment, processing, and final abatement of residues. Waste must be collected separately based on their types. Waste transport can be to some local or regional pre-treatment facility, or directly to some regional or national processing facility, such as a waste incineration plant. In Indonesia, there are TPA (Tempat Pemrosesan Akhir) as one of final processing facility. Local or regional pre-treatment may include compressing, sorting, separation, drying, storage and so on. But this treatment can change based on conditions of the country. Today, waste processing often yields some valuable product, such as electricity, compost or synthetic crude oil [6]. Solid Waste Management (SWM) is a major part of the social system [7]. SWM become part of social system as its benefit for the community.

Waste Bank is one of several concepts in waste management model. Waste bank as waste management model in the form of waste management business by applying the principle of the 3-R (Reduce, Reuse, Recycle). The system implemented is a system to manage waste, to accommodate, to sort, and to distribute the waste to other waste treatment facility or to those who need it [8]. For example some company that use recycle material for their products.

This paper gives a review from available literature about waste management problems with a focus on the waste bank activity. The purpose of this paper is to guide the reader about waste management problems. Especially, to find factors affecting the continuity of the household waste management through community participation in waste bank activity so then it can provide solution to maintain the continuity of household waste management activities through community participation in waste bank activity.

Although it is generally agreed that wastes management services are essential services that must be provided in every society, nonetheless very little is known on what exactly constitute a waste. Knowing that the concept of waste is highly subjective as one man's wastes is a resource to another. Hence, it is important to have a clear guide as to what could be classed as waste. The present research therefore examines the concept of wastes and wastes management with a view to determining what waste is, how they are classified and managed.

According to the World Bank and USAID, municipalities in developing countries usually spend 20–50% of their available municipal budget on SWM, which often can only stretch to serve less than 50% of the population [9] [10]. Cost-effective techniques for minimising waste include public education (by the government and local or international environmental organization) and citizen encouragement to use and share the design of household recycling processes [11]. The success of household recycling programs strongly depends on citizens' participation in the source separation process. This process requires people to separate their household wastes and special products from their household wastes [12].

There are some aspect that influence household waste behaviours. Attitude, subjective norms, perceived behavioural control, moral obligation, self-identify, intention, action planning, and past behaviour significantly predicted household waste behaviours [13]. We can conclude citizens participation and their attitudes towards waste is the key to success in waste management. Citizens' attitudes are influenced not only by impacts, but also by a lack of credibility in waste managers, decision makers, decision processes, and control mechanisms for waste facility siting and operation. Without a clear or

open decision making process, siting of undesirable facilities becomes an extremely difficult task. The decision transparency and information accessibility are key factors for public acceptance.

Nowadays, there are still many people who are less concerned about the importance of waste management and processing which is also a significant problem for solid waste management system.

II. SOLID WASTE MANAGEMENT

Humans generate solid wastes as by-product from all of their activities. Disposing of these solid wastes has become a big challenge, especially as population densities have grown over the year. Actually, waste deposits have been associated with human habitation since prehistoric times. Solid waste consists of a diversity of objects from a variety of sources [14]. Solid waste's source is depend on population or citizen's behaviour.

Household waste is one of the hardest sources of waste to manage effectively. It consists of a diverse range of materials (glass, metal, paper, plastic, organics) totally mixed together because it's benefits. MSW composition is also has several variety, both seasonally and geographically from country to country, and from urban to rural areas. On the contrary, commercial, industrial, and other solid wastes (except from household) tend to be more homogeneous, with larger quantities of each material. A system that can be devised to deal effectively with the materials in household waste should be possible for management of other sources of solid waste [1].

The production and disposal of large amounts of waste is still seen by many people to be a loss of the earth's resources. Putting waste into holes in the ground appears to be inefficient materials management. It needs to be remembered that although the earth is an open system regarding energy, it is essentially a closed system for materials. Energy and material is two different thing that has their own management. Whilst materials may be moved around, used, dispersed or concentrated, the total amount of the earth's elements or materials stays constant (with the exception of unstable radioactive elements). Thus although resources of 'raw materials' may be depleted or decreased, the total amount of each element present on Earth remains constant. In fact, we mus accept that the concentration of some useful materials is higher in landfills than in their original raw material ores. Such materials could be dug up at a later date [1]. Unfortunately, to dug up the useful materials from landfills cost more money.

Landfilling is one of waste management method by putting waste in holes in the ground. Landfilling could be considered as long-term storage of materials rather than actual disposal. Concerns over conservation of resources

have led to calls for general reductions in the amount of waste generated (waste minimisation or waste reduction) and for ways to recover the materials and/or energy in the waste, so that they can be used again. Recovery of resources from waste should slow down the depletion of non-renewable resources, and help to lower the use of renewable resources to the rate of replenishment.

Waste management models can improve the basis for waste management's decisions [15]. One of the solution is modelling of waste generation. This is a useful way to anticipate the design of waste management strategies as a function of demographic changes and development. Modelling of waste generation can approximate future management needs, based on predictions according to social and economic changes. This process should lead to a more sustainable approach for waste management in terms of policy and waste practice alteration [16].

It is widely recognized that solid waste management is not only a technical problem but strongly influenced by political, legal, socio-cultural, environmental, and economic factors, as well as available resources. Moreover, these factors have interrelationships that are usually complex in the waste management system. This complexity depends on citizen's behaviour towards SWM. It is suggested that appropriate solutions to the complex waste management problems be sought from a system perspective, taking into account all of the above factors in the local area [17].

To increase people's acceptance level of an SWM facility, dialog with neighbors or public involvement in the planning stage has become popular. Nowadays, these procedures are widely discussed because it's benefit to increase people's acceptance of SWM facility. It is essential to understand people's concerns and concepts of SWM management facilities through communication. It is because people with different background will have different way of thinking. This is also essential for better solid waste management practice [7].

As [18] mention, waste management takes place at the interface between the anthroposphere and the environment. The definition and objectives of waste management have changed over time and are still changing. The changing point in waste management based on people's behaviour. The first signs of organized waste management appeared when people started to collect garbage and remove it from their immediate living areas to have comfortable living. This was an important step regarding hygiene and helped to prevent epidemics among the people. These practices were improved over the centuries. However, dramatic changes in the quantity and composition of wastes during the 20th century caused new problems. First, the emissions of the dumping sites (landfills) polluted groundwater because it produce

leachate and produced greenhouse gases. Second, landfill space became scarce in densely populated areas. Even the concept of sanitary landfilling could not solve these problems in a long time. Today, waste management is an integrated concept of different practices and treatment options comprising prevention and collection strategies; separation steps for producing recyclables or for subsequent processing using biological, physical, chemical, and thermal treatment technologies; and different landfill types. People now have the opportunity and the duty to separate paper, glass, metals, biodegradables, plastics, hazardous wastes, and other materials into individual fractions. The goals of modern waste management are to:

1. Protect human health and the environment
2. Conserve resources such as materials, energy, and space
3. Treat wastes before disposal so that they do not need aftercare when finally stored in landfills

Solid waste management practices were initially developed to avoid the adverse effects on public health because the increasing amounts of solid waste being discarded to the environment without appropriate collection or disposal. Managing this waste more effectively is now a need and a duty that society has to address. In dealing with the waste, there are two fundamental requirements: less waste and an effective system for managing the waste still produced [1]. The Brundtland report of the United Nations, Our Common Future mentioned by WCED, 1987, clearly explained how sustainable development could only be achieved if society in general, and industry in particular, learned to produce 'more from less'; more goods and services from less of the world's resources (including energy), while generating less pollution and waste [1].

Those waste management strategies that focus on source reduction, resource recover, and reuse have proven to be more cost effective over the long run or in the near future. They are less damaging to the environment because they prevent or minimize waste generation at the source [19]. Based on [14], the methods of managing solid waste are as follows:

1. Source Reduction. Prevention of solid waste generation.
2. Recycling. Diversion of specific items from the solid waste stream for other uses (such as composting).
3. Combustion. Combustion of solid waste to reduce volume and in some cases to generate energy.
4. Landfilling. Disposal of solid waste by burial.

III. RECYCLE BANK

Municipal solid waste (MSW) source separation is considered an effective solution of reducing waste disposal, enhancing recycling and reducing environmental damage caused by landfilling [20]. MSW source separation refers to the process of separating waste into several categories according to their different characteristics by the household, prior to further treatment [21]. Source separation systems involve higher investment costs compared to mixed waste management systems, because there are higher collection costs, additional workers needed, infrastructure adjustments, new equipment and collecting vehicles, Mechanical Biological Treatment (MBT) facilities, public education, etc. [22]. Solid waste source separation requires a complex system including the purchase of additional collection equipment as well as promotional activities for attracting public awareness [23]. Attracting public awareness can help because it can change people's perspective about waste separation's importance.

Materials are recovered from MSW by separate collection programs. There are two main options to separately collect materials: first is "the bring" and second is "the house-to-house kerbside collection systems". With the first method, putrescibles, recyclable materials (e.g. paper, plastic and glass bottles, cans and other metals, textiles, etc.) and residual waste (or "residue") are delivered to several collection banks sites. On the opposite, materials are collected door to door with the kerbside system. The separate collection centres (SCCs), where the citizens can deliver the recyclable fractions of MSW, allow to integrate the two collection modalities as well as to exploit the advantages of the two systems and minimize their defects [24]. Usually, they are fenced and manned areas, equipped to weigh and collect mainly recyclables. They can also be considered as educational centres because they are places where people can be informed about waste management and made aware of the separate collection program rules, actions for the reduction of waste production, improvement of waste management, etc [25].

For example in Bangladesh, small-scale picking, sorting, cleaning, trading and processing of inorganic recyclables is tolerated without official authorization of the authorities. There is a common understanding that the informal recycling sector helps reduce amounts of waste. The waste does not need to be transported and landfilled by the Municipalities. Estimates of total generated solid waste being recycled by the informal sector range from 4% to 15%. Informal recycling is also acknowledged in the national 3R strategy as an important source of income for the poor citizens. Despite the hazardous and unstable working conditions in the informal sector, such activities

contribute to poverty reduction, which is also in the interest of society and the Government [26].

The formal recycling sector is driven by global resource scarcity and regional demand for recyclable materials to feed domestic and foreign industries. Policy incentives such as tax holidays for up to 5–10 years for all waste treatment and recycling plants help enhance opportunities from formalization for recycling enterprises. Formalized recycling companies however will still buy recyclables from informal traders to help their economic condition. Informal and formal sector is not a clear-cut one for their different. The level of formalization in the sector is progressive. Formalization is the process by which authorities register and authorize individual businesses that comply with rules and regulations. For small scale traders and recyclers, formalization means having to comply with norms and requirements of the authorities. The authorities such as registration of the business, environmental clearance, and authorization for the use of the land for shops and facilities. All these requirements are associated to high costs and long delays, which are clear disincentives for informal traders and recyclers to change their status quo where they are tolerated and do not need to comply with any formal regulations. Strictly enforcing current regulations on the informal sector is not of great interest to the local authorities as this would reduce the current recycled amounts which then again would additionally burden the waste collection and landfilling process and negatively impact on the living environment. The local industry, producing housewares, food and beverage packaging, or ready-made garments, are main buyers of recycled materials. Even though their quality is lower, these recycled materials are competitive on the market because they are cheaper than the virgin materials.

The international market for recycled materials, with a large demand from China, Japan and also India, is further triggering more recycling activities in Bangladesh [27]. Waste recycling should be operated in a free market and systems. They are free to choose which end market best suits their needs in terms of price and quality depending on material demand [28].

Based on the study, recycle bank or waste bank is one of the solution in waste management that can be applied because it has economy and social basic. Recycle bank aims to encourage recycling and environmentally-friendly habits. It brings people, businesses, and communities to achieve big scale impact by participating in household recycling and teaching how to live with more sustainable lifestyles.

IV. WASTE BANK BENEFITS

The existence of a waste bank encourages the community activities on solid waste sorting and recycling. The customers of waste bank take an advantage of sorting and recycling solid waste, because they can gain money from selling recyclable waste [29]. It really help to build up their economic conditions.

There is a need to study the waste bank's economic viability because the studies related to the waste bank, especially because the waste bank's budget performances are very limited. Based on data collection, it seems that waste bank has contributed to reducing inorganic municipal solid waste disposed to landfills by more than 1.5% every year. The number of waste bank's members tends to increase every year. The increasing number of waste bank's members means that there is an increasing amount of community participation in separating waste at its source [30].

As [31] mentioned, two towns of peri-urban settlement in Thailand were investigated in case studies to compare eco-performance between the towns with and without implementation of the CBM program. MSW mass flows and MSW utilization records in 2013 were studied to examine climate co-benefits from waste utilization activities. The results indicated that waste banks in the CBM program can effectively prevent most of recyclables from entering landfills. The practice of waste bank recycling rate from the case study with CBM is 172.20 kg per member per year, which is about 926% higher than average CBMs with MSW recycling. The success of CBM can be attributed to its curbside collection service and fair and friendly pricing of recyclables. The study also found that if the town decided to prevent wastes from landfilling, carbon intensity of the MSW system would be 0.47 tons of CO₂-eq per ton of collected MSW. The landfilling cost would be along 7.41 USD per ton of MSW as landfilling cost. Current MSW reutilization rate has achieved 9.68% of generated waste, can avoid 16.80% of GHG emission, together with a reduction in landfill costs of 11.57% with CBM program. Two scenarios of waste utilization in Thailand were explored and compared, in terms of which scenarios yielded the highest co-benefits. From the comparison result we can choose the best method to MSW utilization.

The study from [31], indicates that by involve local mechanism and community to develop with operational waste banks, the efficiency of collecting recycling wastes will be increase. A similar system can be applied to other communities in other countries. This has so many benefit for other countries because there are solution they can take for their country's future SWM.

Based on the study from [30], there are some advantages received by waste bank's members in transaction with

waste bank than to the informal sectors. The advantages are:

1. Buying price of recyclable waste from waste bank is higher than the informal sectors.
2. Waste bank has a cooperative system (savings and loans).
3. Waste bank has a clear recording of each member's transactions.
4. Seventy kinds of recyclable waste can be accommodated by waste bank

The advantages make people more convenience in selling their recyclable waste to waste bank. The level of people's trust in dealing with waste bank is higher than with the informal sectors.

From the study above, we can know the benefit of waste bank as follow,

1. Reducing municipal solid waste disposed to landfill
2. Increase citizens economic viability

V. WASTE BANK CONTINUITY PROBLEM

To combat this ever-growing mountain of waste, policy-makers have embraced the 3Rs concept with special emphasis placed on recycling, albeit last on the 3Rs hierarchy. Though recycling has gained political momentum, such efforts must be made in concert with reduction strategies, as recycling alone is insufficient to cope with the environmental impacts of current consumption rates in a growing population [32]. Therefore, recycling is not a goal in and of itself, but rather a necessary response to societal consumption patterns [33].

A country's specific context conditions how waste management practices are established so far and can be further improved for the future. Specificities of policy instruments and market incentives for urban solid waste management in Bangladesh is one of the example of current policy in developed country. Based on this initial research centred on Bangladesh, a comparative framework in terms of policy instruments and market incentives can be developed as a further research project in order to enable mutual learning between Bangladesh and other countries currently facing, or having faced in the past, similar urban solid waste management challenges [27].

Apart from the incentive to push recyclable waste into the recycling channel, demand for recycled materials drives the market. The price paid for recycled materials is very important for the competitiveness of recycling initiatives. The capacity of the processing facilities (separating, sorting, etc.) in various countries also differs. Some facilities in countries with relatively more developed waste recycling system and advanced technology have a problem of over-capacity. UK is at risk of heavily over-

investing in residual waste treatment infrastructure. If all of the facilities with planning consent are to be built, UK will have 5 million tonnes more capacity than it requires [28]. Countries like Germany and Sweden have already a problem with over-capacity, mostly in the sorting plants. The waste management is a major issue in most of the developing countries in the world. India and China are two faster growing economies who also have similar problems in waste management, especially because large amount of waste they produce. Moreover, with the population growth and the increasing GDP, the MSW generation rate is increasing proportionately. Both the countries investing a loads of funds in landfill sites, MSW handling and treatment, but the problem is not resolved. The main constraint is the awareness of the citizen and poor institutional initiative [34].

The current regulation system in developing country is not perfect, and the existing management system and the collection facilities do not fit the present requirements at all. Another problem is waste collection without separation, treatment facilities are limited, and the collected wastes dumped carelessly in open areas. Government, NGOs, CBOs and private sectors are working hard in this field but still the action is not enough. The main management strategies to remedy this should include amendment of current laws and regulations, improve current management systems and introduce classified collections to citizen [35].

Based on [36], most of Asian developing countries have solid waste generation problems. The main core problem are incompetent organization and limited budget allocation from the government that cause solid waste reduction is started from the source up to the landfill sites. Alternative solutions of solid waste management that can be adapted for Asian developing countries are social and technical approaches. Social approaches are changing the public behaviour by improving community through training, and encouraging partnerships with decentralized solid waste management. The technical approaches are reducing biodegradable solid waste at source, converting waste to energy, and using simple but effective technology. These approaches in social and technical aspect are expected to improve the sustainability of SWM in Asian developing countries.

Based on the research through in-depth interviews of key informants in the community groups that carry out the activities of waste banks in five locations in Bandung, it is noted that waste bank problem is similar to SWM problem. The main problem for their continuity in society is limited budget, current regulation system is not perfect, and the awareness of citizens is low.

VI. WASTE BANK CONTINUITY FACTOR

Waste bank continuity factor is similar with waste management continuity factor. Municipalities have failed to manage solid waste due to financial factors and their country's economy condition. The huge expenditure needed to provide the service [37], the absence of financial support, limited resources, the unwillingness of the users to pay for the service [38], and absence of right use of economic instruments have hampered the delivery of proper waste management services. [37] indicated that the involvement of the private sector is a factor that could improve the efficiency of the system.

Waste management is the sole duty and responsibility of local authorities, and that the public is not expected to contribute [39]. However, public participation in waste management has important place to increase waste management efficiency. The operational efficiency of solid waste management depends upon the active participation of both the municipal agency and the citizens. Socio cultural aspects mentioned by some scholars include people participating in decision making [37], community awareness, and societal apathy for contributing in solutions [40].

Management deficiencies are often observed in the municipalities. Some researchers that have investigated the institutional factors that affect the system have come to the conclusion that local waste management authorities have a lack of organizational capacities especially in leadership factor and professional knowledge. The information about waste management system which available is very scanty from the public domain [41]. The extremely limited information is not complete or is scattered around various agencies concerned, therefore, it is extremely difficult to gain an insight into the complex problem of municipal solid waste management [42].

Waste workers are usually associated to low social status [39]. This situation's result is low motivation among the solid waste employees. Politicians give low priority to solid waste compared to other municipal activities [40] with the end result of limited trained and skilled personnel in the municipalities [37]. Major positive factors that improve the system are support from municipal authorities [43] and strategic plans for waste management that makes monitoring and evaluating annually for the system easier [44].

Waste management is also affected by the aspects that facilitate the effectivity of the system. The aspects are technical, environmental, financial, socio-cultural, institutional, and legal. Household's attitudes and behaviour related to separation of waste depends on active support and investment of a real estate company, community residential committees' involvement for public participation, and fee for collection service [45].

Household waste utilization and separation behaviour also depends on gender, peer influence, land size, location of household, and membership of environmental organization. Lack of knowledge of treatment systems by authorities is reported as one factor affecting the treatment of waste [41].

The availability of waste facilities affects waste disposal choice. The limited number of waste containers along with long distance to get the waste container will make people prefer to dumping the waste in open areas and roadsides. Lack of financial resources limiting the safe disposal of waste in better equipped and engineered landfills and absence of legislation are mentioned by [46]. [47] suggests that the quantity of solid waste generation is lower in countries with lower GDP. As mentioned, there are three most important components in relation to the separation of waste. These components are:

1. **Awareness.** The efficiency of waste separation depends on the awareness of citizens about the impacts of waste management systems in the city.
2. **Knowledge.** Decision makers at the municipality are prone to set up waste separation programs when they are familiar with new and appropriate technologies as well as good practices for the management of waste.
3. **Equipment.** The availability of equipment and machinery to manage and recycle waste seem to be key factors that promote separation of waste at the household level.
4. **Support:** Central and local government, service providers and service users' support to the system are key elements for the efficiency of the collection, transfer and transport of solid waste.
5. **Infrastructure.** In general, municipalities are responsible for the infrastructure and equipment needed for waste collection, transfer and transport. The improvement of the infrastructure affects positively the efficiency of the system

From in-depth interviews of key informants in the community groups that carry out the activities of waste banks in five locations in Bandung, awareness, knowledge, and support from local authority become major factors affecting the continuity of waste bank activities.

VII. CONCLUSION

Waste bank is one of the solution in waste management that can be applied to encourage recycling and environmentally-friendly habits. People, businesses, and communities are bring together to achieve big scale impact by participating in household recycling and teaching how to live more sustainable lifestyles. The main problem of waste bank continuity is limited budget,

current regulation system is not perfect, and the awareness of citizens is low. The solution for waste bank continuity is to correct current waste management system based on several factor : awareness, knowledge, equipment, support, and infrastructure.

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