

Challenges of Urban Space for Sustainable Solid Waste Management in the Langat Basin, Malaysia

Cabaran Ruang Perbandaran terhadap Pengurusan Sisa Pepejal Lestari di Lembangan Langat, Malaysia

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ABSTRACT

Urbanization process in the Langat Basin, Malaysia, grow rapidly for the past three decades. The land use change urban areas of the basin increased from 2.3% in 1974 to 32% in 2010. While the population experiencing rapid growth from 665,395 in 1991 and increase to 1,492,422 in 2015. The vibrancy of economic activities with increasing of population, leads to increasing generation of solid waste in the basin. Solid waste generation increased from 332.7 ton/day in 1991 and increased to 1,641 ton/day in 2015. The current practice of waste management in the Langat Basin still focus on disposals to landfill. Previously there are nine landfill supporting the needs of the basin, however there are only three landfill left. The landfills closed were due to pressure from the development of residential, commercial and industrial areas. The demand for new landfill will compete for space with other economic activities and security of ecosystem services. Land are so precious, thus priorities will not be given for landfill in the Langat Basin. Hence there is a need for change of waste management. Priority should be given to resource recovery with waste recycling, waste reduction and waste reuse as the main approach, with support of other strategic plan such as designing product and system as well as using incinerator to ensure reduction of solid waste flow to landfill. These approaches and strategies will able to reduce dependency of space for new landfill in the Langat Basin in the future.

Keywords: Space; urban; waste; demand; landfill

ABSTRAK

Proses perbandaran di Lembangan Langat, Malaysia, berkembang pesat sejak tiga dekad yang lalu. Perubahan penggunaan tanah kawasan bandar di Lembangan Langat meningkat daripada 2.3% pada tahun 1974 kepada 32% pada tahun 2010. Sementara itu pertumbuhan penduduk juga mengalami perkembangan yang pesat daripada 665.395 pada tahun 1991 dan meningkat kepada 1.492.422 pada tahun 2015. Kerancakan aktiviti ekonomi dengan peningkatan penduduk, membawa kepada meningkatkan penajanaan sisa pepejal di Lembangan Langat. Penajanaan sisa pepejal meningkat daripada 332,7 tan/hari pada tahun 1991 dan meningkat kepada 1,641 tan/hari pada tahun 2015. Amalan semasa pengurusan sisa di Lembangan Langat masih memberi tumpuan kepada pelupusan ke tapak pelupusan. Sebelum ini terdapat sembilan tapak pelupusan menyokong keperluan lembangan, namun hanya terdapat tiga tapak pelupusan kini. Tapak pelupusan ditutup adalah disebabkan oleh tekanan daripada pembangunan kawasan kediaman, perdagangan dan perindustrian. Permintaan untuk tapak pelupusan baru akan bersaing dengan aktiviti-aktiviti ekonomi yang lain dan keselamatan perkhidmatan ekosistem. Tanah yang begitu berharga, dengan itu keutamaan tidak akan diberikan untuk tapak pelupusan di Lembangan Langat. Oleh itu terdapat keperluan untuk perubahan pengurusan sisa pepejal. Keutamaan perlu diberikan kepada sumber pemulihan dengan kitar semula sisa pepejal, pengurangan sisa pepejal dan sisa pepejal digunakan semula sebagai pendekatan utama, dengan sokongan daripada pelan strategik yang lain seperti merekabentuk produk dan sistem serta penggunaan insinerator untuk memastikan pengurangan aliran sisa pepejal ke tapak pelupusan tidak berlebihan. Pendekatan dan strategi ini akan dapat mengurangkan kebergantungan ruang untuk tapak pelupusan baru di Lembangan Langat pada masa hadapan.

Kata kunci: Ruang; bandar; sisa; permintaan; tapak pelupusan.

INTRODUCTION

Economy, social and physical development are the main factors for development process of a country. These three factors play important role in

determining the level of development process and what have been achieved. Most of the development process happens in an urban areas. Hence in Malaysia, its development process was measured base on the urbanization process which includes

its economic growth and social development. The dynamics of the Malaysian urbanization process resulted too many positive and negative impact. One of the main aspect that require critical attention from rapid urbanization process in Malaysia is its waste management. The need for sustainable waste management is critical as its generation increases with population growth and economic activity. This is true, as cities grow demand for consumption of resources will continue (Schulz 2007; Fernandez 2007). With increasing metabolism process, waste generation increases and that requires more services and support system which include land space, infrastructure, technology, financial and human resources. Cities with limited resources such as land for space will require strategic management system where they are able to manage their wastes in a sustainable manner.

As cities grow the demand of space for economic and social development increased. Urbanization process in Malaysia especially in the Langat Basin, which experiencing rapid urban growth since 1990s, shows the increasing demand of land for development. This leads to uncertainties for suitable land for landfill to ensure efficient waste management. There is a need to have strategy and action plan to handle this critical issues, if the urban waste still manage using an end-of-pipe approach, where landfill is the main options. One of the important strategies is to implement waste recovery to reduce dependency on limited space, human resources and capital. This strategy help to reduce flow of waste to the landfill and increase the lifespan of a landfill or maybe the cities will not require to have new landfill in the future.

MATERIALS AND METHODS

The study was conducted by using secondary data obtained from government agencies and other research institution. Field observation helps in verifying the secondary data and to understand the process of change and determining implication of urbanization process to waste management and landfill issues. Analyses of landuse change and landuse drivers provide important scenario on what going on in the Langat Basin physically and space change towards waste management and landfill requirements. Population change was conducted to assess the impact and demand for efficient waste management and wider coverage

of services. The analyses use secondary data from Statistic Department of Malaysia. Waste generation and landfill management analyses provide picture of waste management issues. This includes to determine the trends of waste generation by household and analyses of landfill lifespan and needs. Findings from landuse change and population change analyses were compared with waste generation and landfill management analyses to assess issues of competitiveness of space for landfill. This will help to assess important factor which will be use to determine the strategy and action plan.

URBANIZATION IN THE LANGAT BASIN

The Langat Basin lies adjacent and to the south of the Klang Valley. It is divided into five administrative areas, namely, Putrajaya, Municipal Council of Kajang (MPKJ), Kuala Langat District Council (MDKL), Sepang District Council (MDSpg), and Seremban District Council (MDS) in the state of Negeri Sembilan. Map 1 shows the Langat Basin and its location within the Peninsular Malaysia. The development process in the Langat Basin was influenced by the introduction of the Malaysia National Economic Plan (NEP) and subsequent Malaysia Plans. At the early stage of development, forestry, agriculture and tin mining were the major forms of landuse in Selangor during the 1970s and 1980s. The main agricultural crop was rubber, which were mainly planted on large commercial estates and smallholdings, and oil palm extensively on the coastal plain. Coffee is cultivated mainly in Sepang and Kelang, and tea in Bukit Cheeding, Kuala Langat. Rubber and palm oil was further intensified as the main crops for the purposes of export, thus increasing the amount of land cultivated for agricultural purposes (Wong 1974). In the 1980s, palm oil became the dominant crop, with rubber experiencing a 40% decrease from 1980 to 1990 as more of rubber estates were converted to palm oil estates. During the 1970s and 1980s decade, the basin remained predominantly agricultural with rubber and palm oil being the main commercial crops in the basin. Not many industrial park for manufacturing industry.

However the game changes of the Langat Basin was seen in the early 1990s when three mega projects development take place. The three mega projects Kuala Lumpur International Airport (KLIA), new capital city of Malaysia, Putrajaya and Multimedia

industry city, the Cyberjaya. The development of these three projects located in the middle of the basin, drive the fast growth of urbanization process. The adjacent areas of these three mega projects are adapting to the changes to provide the necessary support for the projects such as housing, infrastructure facilities and social amenities. With such development process and new economic opportunities, the social development process take place which leads to the increasing of the population in the Langat Basin. Population growth. With this development, demand for more resources such as land, water, infrastructure and other amenities will grow. The population of the Langat Basin grow are shown in Table 1. In supporting the urbanization process and to accommodate the need for economic activities and social needs, demand for housing also

increased. Table 2 shows the trends of housing in the Langat Basin. These two data is very important as to show the critical and increasing demand for effective waste management in the basin. Table 3 illustrate landuse change in the Langat Basin. Urbanization process has lead to increasing space from 7,022 hectares in 1974 to 62,978 hectares in 2014. This shows almost 900% change and the space for urban areas are continuously increasing. The State and Federal Government will maintain forested areas hence there will be no more changes of forest areas in the future. Therefore most of the changes of landuse in the Langat Basin was from agriculture to urban built up areas. The process of the rapid changes will affect waste management especially to determine suitable areas for new landfill.

TABLE 1. Population Growth in the Langat Basin

Year	1970	1980	1991	1999	2004	2009	2014
Number of Population	282,966	411,495	666,129	1,073,865	1,333,616	1,637,728	1,762,179

Source: Department of Statistics 1995, Selangor 2004.

TABLE 2. Housing Trends in the Langat Basin

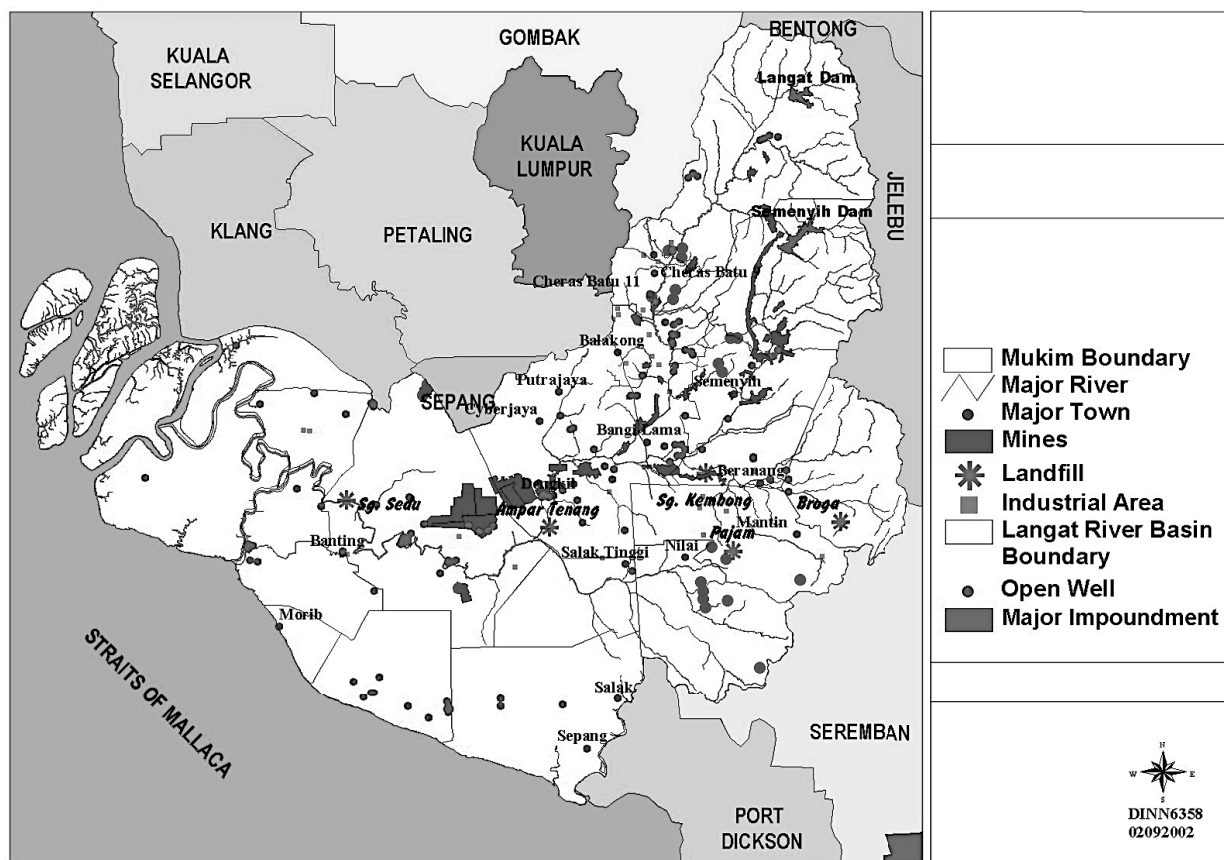
Year	1999	2004	2009	2014
Number of House	236,930	311,005	386,255	451,650

Source: Department of Statistics 1995, Selangor 2004.

TABLE 3. Landuse change Langat Basin 1974 – 2014 (in Hectares)

Landuse	1974	1981	1988	1991	1996	2001	2014 (estimate)
Forest	127,831.3	121,509.4	88,920.9	87,652.4	80,571.2	70,702.8	69,288.7
Built Up Area	7,022.8	7,601.5	28,194.4	28,150.7	30,968.3	51,502.8	62,978.6
Agriculture	155,248	160,733	170,016	170,705	176,640	164,541	154,668.5
Water Bodies	3,267.3	3,496.6	6,170.1	6,401.5	5,132.5	6,307.1	6,117.9

Source: Modified from Mazlin et al. 2009



MAP 1. The Langat Basin Malaysia and location of landfill.

WASTE MANAGEMENT IN THE LANGAT BASIN

The waste management in the Langat Basin follows the federated governance approach and system. The waste management has gone through many changes and development. The latest development was in establishing policy and legal system prioritizing waste recovery and minimization which has shown the government commitment and seriousness. The transition is shown here, where previously the solid wastes management falls under the jurisdiction of Local Government Act 1976, Street, Drainage and Building Act, 1974 and Town and Country Planning Act. While scheduled wastes are directly managed under the Environmental Quality Act (Scheduled Wastes), Regulation 1989. These legislations are not equipped with requirements for waste recovery system. Hence the focus of this legislation more towards cleaning the cities and send the waste to landfill, prioritizing end-of-pipe approach. During these period of legislation, more landfills were built in many cities including cities in the Langat

Basin. When the wastes issues critical and there is a problem to determine suitable land for landfill, the government has reviewed the law and established more comprehensive legislative tools for sustainable waste management in Malaysia.

The reviewed process established policy and legislation for waste management specifically for solid waste to ensure that waste manage in a sustainable manner. The National Solid Waste Management Policy 2007 and the Solid Waste and Public Cleansing Management Act (SWPCMA) 2007 were established to prioritize waste minimization and recovery as a resource. While for schedule wastes Environmental Quality Act 1974, Schedule Waste Regulation 2005 promotes schedule wastes recovery as a resource with a special requirement. SWPCMA steered by the National Solid Waste Management Policy and The National Strategic Plan for Solid Waste Management. SWPCMA will implement sustainable waste management based on waste management hierarchy which prioritizes waste reduction through 3R, intermediate treatment and final disposal as well as emphasis on

environmental protection and public health (Abdul Nasir 2007). These policy and act will ensure that the ecosystem function and services of the Malaysian cities will be able to support the increasing volume of wastes generated.

These changes of governance and legislation was found not easy to change the existing practice of waste handling by communities, industries and business. The current scenario still maintain end-of-pipe approach thus the landfill is still needed. Study found that the amount of solid waste generated in Malaysia increased significantly from 16,200 tons per day in 2001 to 19,100 tons per day in 2005 or an average of 0.8 kilogram per capita per day (Malaysia 2006). The existing trends of waste generation for national level show an increasing trends. Waste generation increase from 19,000 ton/day or 0.8Kg/day/person in 2005 and increased to 33,000 ton/day or 1.1Kg/day/person (SWCorp 2014).

The Langat Basin waste generation also shows an increasing trends, Table 4 illustrate that household waste generation in the basin increased from 226 ton/day in 1970 to 1,938 ton/day in 2014. This does not take into account the waste generated from industries, business and institution. The increased of waste generation from household in the Langat Basin which count for more than 800% from 1970 to 2014 shows that the waste management is a very important aspect for the city managers. Moreover with low recycling rate where its increases at a very low growth rate from 5% in 2005 to 10.5% in 2012, not able to reduce waste generation significantly hence the needs for landfill is still essential. Therefore the local authorities have to use in average 30% of the annual expenditure for waste management. There are local authorities in the basin spend more than 40% of their annual expenditure.

TABLE 4. Household Waste Generation (ton/day) for the Langat Basin

1970	1980	1991	1999	2004	2009	2014
226.37	329.19	532.90	859.09	,066.89	1,801.50	1,938.39

Obviously, the amount of MSW increases significantly with the increasing number of population, where the amount of MSW managed by local government increases from 2.5 million tons in 1991 to 4.6 million tons in 2002 (KPKT 2004). As a result of which, a proper management system is required urgently to manage waste in a sustainable manner. The current system focuses on end-of-pipe approach that requires larger disposal sites. As of 2002, there are 161 landfills available in Malaysia, with different categories and life span ranging from 2 to 8 years.

In the 1990s there are seven landfills in the landfill. However the Langat Basin landfill which is still in operation are left only four landfills, with lifespan between two to six years. The two landfills Broga and Sungai Sedu were closed due to its lifespan. While Air Hitam landfill was closed due to the pressure of urbanization. In fact Air Hitam landfill is the first sanitary landfill with double geo-membrane liner in Malaysia. It supposed to have a lifespan of at least 25 years. However it was closed since uncontrolled housing development moving towards the landfill. After 8 years of operation Air Hitam landfill was ceased its operation and now has been converted as a recreational areas.

Thus if the current management practice is going to be maintained, while wastes generation increases within the existing rate, there will be an increasing demand for new land to be alienated for disposal sites. Hence this will create competition of landuse between population expansion needs, economy activities and waste disposal requirements. This competition might lead to bigger issues such as environmental and human health problems in the Langat Basin.

CONFLICT OF NEEDS FOR LANDFILL IN THE DYNAMIC URBAN SPACE

Rapid urbanization process in the Langat Basin has created problems for waste management. With estimated waste generation increase at the rate of 4.2% a year along with increasing number of population and economic activities, maintaining efficiency will be a big problem for waste managers. Maintaining end-of-pipe approach will require more space for landfill since the existing landfill in the Langat Basin has lifespan less than 6 years.

Low waste recovery rate through recycling, reuse and reduce as well as lack of diversify use

of waste as resources while continuously maintain the flow of waste to landfill, will leads to demand for more landfill, to cater for increasing population and growth of business and industry in the Langat Basin. Government policy to maintain forested areas hence landfill will not be develop in this areas. As for the agriculture the cost will be higher since the most of the agricultural areas are privately own. Although government has put an effort through creation of specific policy and legislation for waste management with support of specific institutions the problems could not be solved in a short period of time. Although education and awareness program has been conducted by many government agencies, local government, waste concessionaires and non-government organizations, it still show low participations of community, industry and business to reduce waste generation and support for waste recovery.

With this situation continues competition of space between the needs for landfill and economic development demand will be one of the problem which need to be deal with to balance the needs for both. What happens to Air Hitam landfill will be a good lesson where closing of the landfill only fulfill the needs for community and economic demand but the waste management facing a huge problem for disposals of increasing waste generated by the population, industry and business in the Langat Basin. Moreover with cost of urban space increased every year, RM 10.00 (USD 2.50) to RM 40.00 (USD 10.00) per square foot in 1994 (depending on location and type of land) has increased to RM 50.00 (USD 12.50) to RM150.00 (USD 37.50) per square foot in 2013 (depending on location and type of land). This will increase the cost for capital and operation for local government and waste concessionaire for new landfill. For effective waste management the landfill location must be located where the cost of transportation are low and transporter able to make at least two trips of collection a day. Current scenario shows that the location of landfill are quite far and most of the transporter only able to do one trip of waste collection a day. To solve this problem concessionaire have to purchase or rent additional truck, which lead to increasing operation costs. Usually this cost will be pass to consumers and hence increase waste charges. Therefore the needs to reduce dependency on waste disposal to landfill is critical and solutions to reduce and divert waste to landfill must be identified.

THE CHALLENGES OF URBAN SPACE FOR SUSTAINABLE WASTE MANAGEMENT

It is important to have strategic and action plan on how to reduce waste flow to landfill and if possible in the future the Langat Basin will not have a landfill. Waste will continuously generated from development process especially from the urbanization process. The continuous flow of materials or resources within the urban ecosystem will ensure efficiency of its metabolism process. The existing linear flow will not able to sustain increasing demand of material or resources for the urban ecosystem in the Langat Basin. Waste recovery as an alternative resource is one of the main options while using ecosystem approach as the main platform. Waste recovery includes waste minimization and recycling. There are two central waste minimisation strategies can be adopted. The first is to deal with the waste after it has been generated and to mitigate its effects on the environment. The second is to minimize the amount of waste generated in the first place, thereby reducing the amount of mitigation required at the end of the pipe. Even when financial returns are not immediate, most waste minimization exercises are as cost-effective as treatment or disposal.

Hence the waste recovery will be the key activity to deal with urban space conflict in reference to waste management. National Strategic Plan for Solid Waste Management was adopted in 2005. This plan prioritize on the reduction, reuse, recovery and recycling of waste as well as greater use of environment-friendly materials such as bioplastics (MHLG 2014). Waste recycling in Malaysian cities is becoming important activities. With increasing amount of solid waste generated each year and reduction of natural resources supply it creates more opportunities. Recycling of wastes, using cycle of materials flow concepts and changes of manufacturing process with technology development, will create alternative resources and promote costs efficiency (Leu and Lin 1998; Orloff and Falk 2003). Moreover with government support through policy, legislation, and economic it will become important activity in the urban ecosystem in the future. Establishment of many recyclers in the Langat Basin illustrate that waste recycling is not only able to reduce the flow of waste to the landfill it also create economic opportunities.

Waste as alternative resources in practice are not only being recovered through 3R approaches. Initiatives to use waste as energy materials has been

started in Malaysia. In the Langat Basin there is an example of waste recovery for energy conducted by Recycle Energy. The company incinerated domestic waste to produce energy. It has a capacity of processing 700 tons of MSW per day at its Refuse Derive Fuel - Waste to Energy (RDF-WTE) plant in Semenyih for the Kajang Municipal Council and district of Hulu Langat. The plant has the capacity to produce 5 Megawatt (MW) of electricity per month which was supplied to the national grid. They have a plan to process solid wastes generated by Ampang Jaya Municipal Council before 2015. In reference to national requirements this has contributed to increase of renewable energy from less than 1% in 2009 to 5.5% (985MW) of Malaysia's total electricity generated by 2015 with 200MW from solid waste sector (MHLG 2014).

The need for waste recovery in the Langat Basin is critical. This will help to ensure sustainable waste management in the cities. The good impact of waste recovery in cities helps to reduce dependency on landfill for expansion or new landfill to accommodate increasing volume of wastes. It will help to reduce input of pollutants to the ecosystem hence minimize pollution intensity mainly to surface water, land surface, soil and groundwater. This activity will create new alternative resources which could be utilized by important sectors especially the manufacturing industry, construction industry and energy industry. Alternative resources from waste recovery will create economic opportunities and help to reduce industry operation costs and increase production efficiency. Waste recovery as resources will ensure balance urban metabolism process where negative output will be minimized.

However with the current situation in the Langat Basin with the needs for suitable space for landfill is still important since the transition of waste management continues at a slow rate to reduce waste flow to landfill and maintain the need for new landfill. Hence there is a need for a strategy to change the mind of the community, business and industry to achieve sustainable waste management. This strategy will include strategic and effective education and awareness program. System or approach which is able to enhance stakeholders' commitment and develop culture to recover waste and reduce waste generation. Hence the need for rigorous activity and program by government and concessionaire to increase waste recovery by community, industry, business and government entity. The program also should include technique or system in creation of

alternative use of waste such as composting, waste to energy, and waste as resources for industry, which will have an economic value. Initiative for industry and business to promote requirements of technology development and choices for waste recovery and to reduce waste flow into landfill. The focus of these strategies is to create and develop culture and practice among the stakeholders to reduce waste and generation and help to divert waste flow which will reduce dependency of landfill and creation of new landfill in the Langat Basin.

CONCLUSION

The competition for urban space will continue if waste is continuously managed with end-of-pipe approach. Since waste management is not a priority in the hierarchy of economic, social and urban development, the existing management system needs to be changed. With the space in the Langat Basin limited and the need to balance space use to ensure the sustainability of the ecosystem services of the basin, there is a need to have in place strategy and action plan which will guarantee that the future waste management is able to reduce dependency on landfill and stop developing new landfill.

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