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Solid Waste Generation and Collection Efficiencies: Issues and Challenges

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Graphical abstract
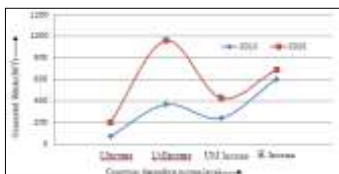
Abstract

Solid waste management is a big challenge throughout the world. It is becoming more complicated with the increased globalization and worldwide urbanization. Solid waste monitoring and management depends on the solid waste generation and collection efficiency. Without an efficient collection system, improvement of the solid waste monitoring and management system is a difficult task. Thus, it is a big hindrance on the way of development of solid waste management and sustainable environment. This paper deals with a comprehensive survey on the solid waste generation and their collection efficiencies. From the rigorous review, it is observed that the existing methods and system, however, not reliable and intelligent enough to monitor and manage the increased level of solid waste. Accordingly, this review is being highlighted on the issues and challenges for future efficient solid collection systems. This review paper may guide the reader about the basics of solid waste generation and their collection process to facilitate the planning and design of a sustainable new system

Keywords: Solid waste collection efficiency;countries according to income level; waste pickers; effect on environment.

Abstrak

Pengurusan sisa pepejal merupakan satu cabaran yang besar di seluruh dunia. Ia menjadi lebih rumit dengan globalisasi dan peningkatan pembandaran di seluruh dunia. Pemantauan pengurusan sisa pepejal dan bergantung kepada penjanaan sisa dan kecekapan pengumpulan pepejal. Tanpa sistem pengumpulan cekap, peningkatan pemantauan dan pengurusan sisa sistem pepejal merupakan satu tugas yang sukar. Oleh itu, ia adalah satu halangan yang besar kepada jalan pembangunan pengurusan sisa pepejal dan alam sekitar yang mapan. Kertas kerja ini membincangkan satu kajian yang komprehensif mengenai penjanaan sisa pepejal dan kecekapan koleksi mereka. Dari kajian yang teliti, didapati bahawa kaedah dan sistem yang sedia ada, bagaimanapun, tidak boleh dipercayai dan cukup pintar untuk memantau dan menguruskan tahap peningkatan sisa pepejal. Oleh itu, kajian ini sedang menekankan kepada isu-isu dan cabaran untuk sistem pengumpulan pepejal yang cekap di masa hadapan. Kertas kajian boleh membimbing pembaca tentang asas-asas penjanaan sisa pepejal dan proses pengumpulan mereka untuk memudahkan perancangan dan reka bentuk sistem baru yang mampan

Kata kunci: Pepejal kecekapan pengumpulan sampah ; negara mengikut tahap pendapatan; pickers sisa; kesan ke atas alam sekitar.

1.0 INTRODUCTION

Waste or rubbish, trash, junk, garbage, depending on the type of material or the regional terminology, is an unwanted or undesired material or substance. It may consist of the unwanted materials left over from a manufacturing process (industrial, commercial, mining or agricultural operations,) or from community and household activities. The material may be discarded or accumulated, stored, or treated (physically, chemically, or biologically), prior to being discarded or recycled.

The control of solid waste pollution is an important aspect of environmental protection throughout the world. With economic development, the quantity of solid waste is increasing rapidly. The increasing trend towards urbanization and population growth combined with a growing environmental concern has created a critical situation for the management of house hold solid waste[1].

The time when waste was just some kind of leftover that had to be disposed of is long gone [2]. Previously, solid waste collection or management was not used to be given much attention. Waste collection was carried out without analyzing demand and the construction of the routes was left to the drivers. So it would have taken longer to collect garbage and due to the absence of a proper system, it was common that many regions were left out. But with the increased urbanization, the realization of the importance of an efficient collection system was increasing.

Solid waste management (SWM) includes different kinds of issues (environmental, technological, economic, legislative, social, etc.) and problems (waste generation, collection, transportation, treatment, and disposal) that should be taken into account in order to find solutions that are economically appealing and environmentally sustainable.Solid waste management is concerned with the control of generation, storage, collection, transportation, processing and disposal of waste according to the principles of public health, economic and other environmental consideration. It is characterized by inefficient collection methods, insufficient coverage of the collection system and improper disposal [3].

Once quantities, characteristics, period and location of waste are determined, it is necessary to classify them. Normally, this classification depends on the national decisions (usually by using regulations). These decisions, generally, are taken by politicians based on some current scientific knowledge. As a result, waste is not always classified and treated as it should be [4].

If waste collection is a municipal service, this involves large expenditures and difficult operational problems.Presently, one of the major objectives in solid waste engineering is to collect refuges effectively as collection of municipal solid waste accounts for between 50% and 70% of the total cost of refuge

management [5].Actually, waste collection and transportation is the contact point between waste generators and waste management systems [6].

The main components for waste collection are collection vehicle, stoppages and depot. A collection vehicle will start from its depot; stop different stoppages to collect generated waste and come back to its depot again. But it is not always this simple. Different regions have different geo-graphical conditions, limitations, political situations, population etc. Depending on the complexity of the problem collection system is needed to be added different characteristics such as different types of vehicles, number of disposal facilities (single or multiple), scheduling, bin allocation/reallocation etc.

Sometimes even if all the facilities are present, waste is not collected properly due to lack of regulations. Most Third World cities do not collect the totality of wastes generated, and of the wastes collected, only a fraction receives proper disposal. The insufficient collection and inappropriate disposal of solid wastes represent a source of water, land and air pollution, and pose risks to human health and the environment [3]. The Municipal Solid Waste generation of Indore Municipal Corporation was 685 tons per day (TPD), out of which only 461 tons per day is collected and transported to dumping ground which results in a collection efficiency of only 67% [7]. In Egypt, collection services cover less that 30% of urban and rural areas and the rest are disadvantaged [8].

The motto of this paper is to give an overall scenario of the worldwide waste generation growth and collection systems in different countries. It will also describe the issues and challenges countries are facing with the increased waste generation.

2.0 OVERVIEW OF SOLID WASTE GENERATION AND COLLECTION

Waste material is an unavoidable by-product of human activities. Economic development, urbanization and improved living standards in cities increase the quantity and complexity of generated solid waste. Rapid growth in urban population leads to a dramatic increase in municipal solid waste (excluding industrial, construction, hospital waste) with severe socio economic and environmental impact[9].

Solid wastes are divided into three main categories: municipal, industrial and agricultural [10]. Municipal solid waste or MSW can be further defined as having the following components [5]:

- Mixed household waste
- Recyclables, such as:
  - Newspaper
  - Aluminum cans
  - Milk cartons
  - Plastic soft drink bottles

- o   Steel cans
- o   Corrugated cardboard
- o   Other material collected by the community
- Household hazardous waste
- Commercial waste
- Yard (or green) waste
- Litter and waste from community trash cans
- Bulky items (refrigerators, rugs etc.)
- Construction and demolition waste

The composition of municipal solid waste varies greatly from municipality to municipality (country to country) and changes significantly with time.

Waste management, cost allocation, creating awareness of pollution due to generated waste etc. varies from nations to nations depending on their income [11]. High income countries are very much aware of the management and maximize the collection of the generated waste in the most efficient and least expensive way by giving proper knowledge to people for reducing waste. Middle income countries struggle on getting up to this standard whereas low income countries are way behind this. These countries spend most of their allocated waste management budget in collection yet cannot collect even 50% of the generated waste.

In many countries researchers are doing a lot of study to introduce intelligent solid waste bin to develop an efficient and dynamic waste management system. They are working on the implementation and execution of integrated sensing system and algorithm for solid waste bin to automate the solid waste management process [12].

Solid waste generation is connected with the income of the countries. Countries with high income tend to generate more waste. But from the estimation it has been seen that at present total waste produced by high income countries is 85,000,000 tons per year, which will be 86,000,000 tons per year in 2025. Whereas, at present this value for middle-income countries and low-income countries are 34,000,000 tons per year and 158,000,000 tons per year, which will be respectively 111,000,000 tons per year and 480,000,000 tons per year in 2025 [11]. In Peninsular Malaysia, around 25,000 tons generated per day (2012 projections) [13]. The household solid waste generation in Turkey, per capita, is around 0.6kg/year, whereas municipal solid waste generation is close to 1 kg/year [14]. The total waste quantity per day at Danang is around 661.6 tons, and it tends to increase dramatically by years and can attain 550 thousand tons till 2020 [15].

A positive correlation tends to exist between a community's income and the amount of solid wastes generated. Wealthier individuals consume more than lower-income ones, which results in a higher waste generation rate for the former [3]. Low income countries with yearly per capita GDP that does not exceed US$ 5000 have the lowest MSW generation rates, which are in the range 0.3 – 0.9 kg/capita/day. The increase in per capita daily generated waste is found linearly proportion to the per capita GDP. In high income countries it reaches a range of 1.4 – 2.0 kg/capita/day [8]. Low-income countries, collection alone drains up 80 to 90 percent of municipal solid waste management budget, whereas, in high income countries it is less than 10 percent of the budget, which facilitates waste recycling and recovery [16]. When local leaders are interested in solid waste management issues, they allocate adequate funding for equipment and infrastructure in these countries [17]. Table 1 shows the comparison of solid waste collection practices based on income level.

Population growth and urbanization growth are related to each other. Figure 1 shows a comparison of population growth and urbanization growth among developed, developing and least-developed countries. Here the growth is shown from the year 1990 to year 2010. Within these years, Developed countries population growth was the least compared to other countries. Population growth of these countries was 11%. It shows an urbanization growth of 4% only. Whereas, least developed countries show the highest population growth and urbanization growth of 41% and 23% respectively. In developing countries these growths are moderate. Population growth is 17% and urbanization growth 9%. Therefore, it is clearly seen from the graph that with increase of population, urbanization also increases.
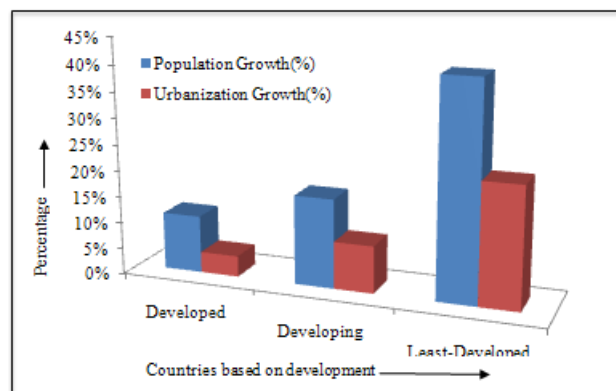

Figure 1 Population and urbanization growth in different countries [8]

Table 1 Comparison of Solid Waste collection Practices by Income Level [11]

Activity	Low Income	Middle Income	High Income
Source Reduction	No organized programs, but reuse and low per capita waste generation rates areCommon.	Some discussion of source reduction, but rarely incorporated into an organized program.	Organized education programs emphasize the three 'R's' - reduce, reuse, and recycle. More producer responsibility & focus on product design.
Collection	Sporadic and inefficient. Service is limited to high visibility areas, the wealthy, and businesses willing to pay. High fraction of inert and compostable impact collection—overall collection below 50%.	Improved service and increased collectionfrom residential areas. Larger vehicle fleet and more mechanization. Collection rate varies between 50 to 80%. Transfer stations are slowly incorporated into the SWM system.	Collection rate greater than 90%.Compactor trucks and highly mechanized vehicles and transfer stations are common.Waste volume a key consideration. Aging collection workers often a consideration in system design.
Costs	Collection costs represent 80 to 90% of the municipal solid waste management budget. Waste fees are regulated by some local governments, but the fee collection system is inefficient.	Collection costs represent 50% to 80% of the municipal SWMbudget. Waste fees are regulated by some local and governments, more innovation in fee collection, e.g. included in electricity or water bills. Expenditures on more mechanized collection fleets.	Collection costs can represent less than 10% of the budget. Large budget allocations to intermediate waste treatment facilities.

And as we know, with increased urbanization waste generation is increasing as well. Developed countries citizens are constantly informed, by radio, television, journals, advertisings etc. about environmental impacts of waste[4]. But due to the lack of proper knowledge, developing and least developed countries are failing to collect and manage generated waste efficiently.
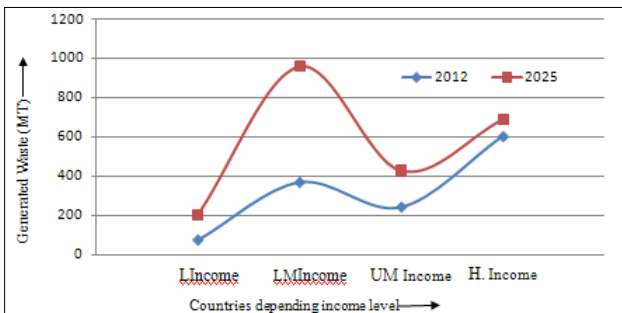

Figure 2 Current and projected waste generation in different income countries[18]

Above graph is a comparison of waste generation among different countries based on their income level. Estimated waste generation in the year 2012 and projected waste generation in 2025 are shown in Figure 2. Here it is clear that lower-middle income countries will generate a huge amount of waste in future. In 2012 they used to produce 369 MT wastes which will be raised up to 956 MT in 2025. High income countries will increase 84 MT in 2025 from 2012. They will give the least increment in waste generation. In low income and upper medium countries it will increase more than high income countries and very less than lower-middle income countries. In LM income countries it can happen due to the rapid growth in population, urbanization,

absence of proper knowledge on waste management etc. If this huge amount is not collected and managed properly, it will cause huge damage to the environment.

Again the composition of the generated waste differs in quantities and waste generation varies from region to region. For example, in China, in year 2000, total Municipal waste Generation was 150,000,000 tons and total Municipal Waste Generation Expected in 2030 is 484,000,000 tons. It has been seen that, in 2000, people using gas produced more waste than people using coal. Gas users produced mainly organic and plastic (65% and 13% respectively) a lot more than coal users (41% and 4% respectively), whereas, coal users produced a large amount of wastes (47%) other than metal, glass, plastic, paper or organic waste than gas users (10%). From the projected value, in 2030, metal and glass waste will increase by 1%. Main source of waste will be organic on that time (51%)[19]. All these values are presented in figure 3 showing the comparison among different waste components according to year.
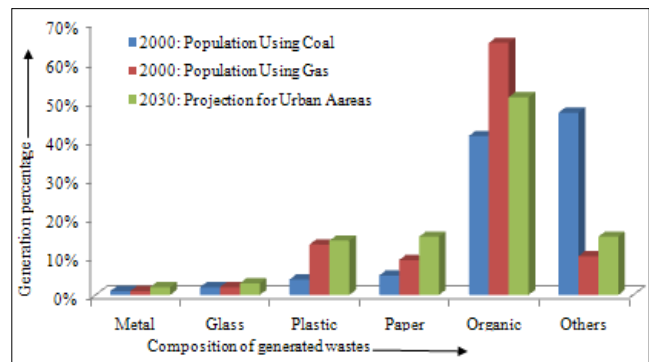

Figure 3 Municipal waste Generation in China [19]

Collection is the most important part of solid waste management. With efficient collection system, it is possible to yield lower operating costs, shorter collection and hauling distances, reduces labor hours. That is why solid waste collection is given priority in first world countries. Every step of collection is planned and pre-determined so that waste can be collected in most efficient way. There is always enough number of garbage collecting vehicles, specific zone for which each vehicle will be dedicated, pre-set route for collection, ensuring proper disposal of waste. In these countries, all the valuable information is always maintained for any kind of future research on improving present condition by the company responsible for collection. For example,all the necessary data for further study like facilities location, waste generation quantities, data for vehicles, labors data and costs data are preserved by the WBD[Wirtschaftsbetriebe Duisburg] the company which is responsible for waste collection and disposal in city Duisburg, Germany[20]. But environmental pollution occurs due to collection vehicles. According to data provided by the European Commission, 19.5% of all greenhouse gas emissions in the EU were caused by transport in the year 2007. Also, road freight transport grew by 2.9% annually between 1995 and 2008 [21].

On the other hand, MSWM in the Third World is unsatisfactory. The improper management of solid wastes represents a source of air, land and water pollution, and poses risks to human health and the environment. Despite considerable expenses, the situation tends to further deteriorate due to the rapid growth of cities likely to occur over the next few decades. Globalization is likely to boost economic growth in the developing world, which would increase the amount of wastes that need to be collected, transported and disposed of, further straining Third World cities [3].

In most of the cities, collection and transportation consume the most part of the budget allocated for solid waste management. Collection cost is approximately $0.05 per km and per ton solid waste[22]. In Greece waste collection and transport accounts for 70-100% of the total MSW costs [23].Typically, 90 percent of Indonesian solid wastemanagement budgets are allocated for activities related to collection: street sweeping, transportation, andvehicle operation and maintenance. If a sanitary landfill is used for final disposal, collection costs decreaseto about 80 percent [11].

3.0 METHODS AND SYSTEMS USED IN DIFFERENT COUNTRIES

In many countries, solid waste management is done by the local authority, whereas in some it is given to the private sector. Before 2011, local authority used to provide this service in Malaysia. But from 2011 they

have fully privatized 8 states of the country [13].Sometimes government makes a contract with small contractors for waste management. In Chengdu waste generated in urban areas is collected by municipal organizations or its collection is run by private companies under some type of contract [24]. Whereas in Buenos Aires, 5 out of 6 zones are operated by individual private operators but one zone is handled by the city government's urban sanitation authority known as the "Ente de Higiene Urbano" (EHU) [25].

In most of the developed countries most part of municipal waste collection is privatized e.g. Germany 55%, UK 56%, France 46%, Spain 76% and Bulgaria 75% [26].

Solid waste collection efficiency is one of the main components for efficient management. Adopting dynamic collection policies can yield lower operating costs, shorter collection and hauling distances, reduces labor hours from the ones resulting from static policies with fixed routes and pre-determined pick-up frequencies that are usually employed by many waste collection operators. Researchers are now also focusing on introducing smart bin with sensors. It will give the waste bin level and the amount of waste inside it by image processing system [27-28]. Some advance studies integrate this technique with communication technologies such as radio frequency identification (RFID), global positioning system (GPS), general packet radio system (GPRS), and geographic information system (GIS) with a camera for solving the problem of solid waste collection and automated bin level detection [29].

Solid waste collection is an exercise in reducing entropy. The pieces that make up the solid waste are scattered far and wide and the role of the collector is to gather these together into one container. In most of the developed countries including the United States, solid waste collection systems are invariably person/truck systems [5]. Door-to-door collection system is very common in USA. But where citizens live in condominiums or apartments, this system does not work. So citizens bring the refuse to the collection point from there collection trucks collect them [24].

There are commonly three types of waste collection trucks are seen. In case of backyard pickup, a larger crew size is needed as the collection point is usually distant from the vehicle. Curbside pickup requires a smaller crew. A fully automated system consists of a truck with two robotic arms to empty the bin automatically. In one California community, automatic collection system is used.Refuse collection system has five phases. Figure 4 shows the flow chart that has highlighted the process of the collection phases[5].
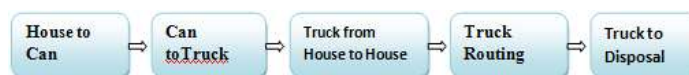

Figure 4 Flow chart of the solid waste collection process

Generally produced solid waste is brought to the garbage can by the dwellers. Then garbage truck goes to pick waste from the can and it keeps on doing it from house to house as long as truck capacity is no met. Truck routing is the most important phase to make the collection efficient. And the last phase is the disposal of waste when capacity is met or at the end of the working hour.

Countries are thinking of reducing the disposable waste by recycling them. Developed countries have already made the collection system efficient by scheduling and well maintained collection vehicles with adequate capacity.They are now practicing separate waste collection system for a long time based on the type of waste as all type of waste do not need everyday collection and sorting after collecting all waste altogether is time consuming. In 1999, it can be seen two states in Italy Brescia and Monza need different collection frequency for different waste type [30].Separate/curbside collection of the recyclable materials is practiced for years in Turkey [14]. For In eastern region of Finland, there are separate collection bins and a specific collection vehicle can collect a specific type of waste. There is fixed time (time window) for collection and disposal of the waste at the end of the day [31].

In developing countries, such collection system is also seen. But informal refuse collectors collecting residual waste is quite common in low-income countries. Sometimes collection trucks cannot travel the narrow road of the city. So there a number of informal collectors are seen. In Santa Cruze, Bolivia, informal refuse collectors serve about 37% of the total population. It can also be seen in the low-income areas of Ciudad Nezahualcoyotl, Chalco and Iztapaluca, near Mexico City. In three municipalities around Mexico City their economic impact is estimated over US$14 million per year [32].

In most of the developing countries, the solid waste generated is collected at fixed stations or door to door. Few of the cities have transfer stations: Ambon, Jogjakarta, Beijing, Bangkok, Dar es Salam, Emfuleni, Langeberg, Pretoria, Gazipur, and Managua. The door to door collection is done by a variety of systems. They are: rickshaw (e.g. Kathmandu, Beijing), animal traction (e.g. Nicaragua, Lahore), wheelbarrow (e.g. Hambatota, Lusaka), tractor (e.g. Langeberg, Balangoda), truck (e.g., Kuthaya, Nakuru), compactor (e.g. Banda Aceh, San Jose), tricycle (e.g. Cañete, Gazipur), motorcycle (e.g. Quezon City, Ambon) and hand trolley (e.g. Masaya, Jogjakarta)[17]. Current manual MSW collection scenario at Danang involving the uses of some semi-automated vehicles such as the tricycles, the forklifts and the hook-lifts that does not guarantee the operation for such huge waste quantities[15].

Developed countries started the awareness of solid waste collection from a very early time. Different collection systems were used from the beginning. Long ago, most waste collection and public cleansing was carried out using horses in London.

Table 2 Overall collection scenario ofLondon in 1928 [33]

Horses	63.3%
Electric vehicles	16.4%, much higher in towns and urban areas with destructors.
Petrol	15.7%, higher in towns under 250,000 population
Horse & Petrol vehicle combination	4%, the 'Container System' used by Kingston and others
Steam traction	0.6%, whose previous great popularity had passed

Now-a-days for the transparency, collection trucks are instrumented with different technologies. For example, integration of Radio Frequency Identification (RFID) and communication technologies e.g. GPS, GPRS and GIS along with camera technologies for solid waste bin and truck monitoring system has been taken into consideration [34].

Different organizations sometimes work with the local authority if any region is suffering from tremendous improper collection system. Such situation has been observed in the case of Bardees, Egypt[35]. Different global agencies help developing countries to improve the waste collection or management system by giving important technical support or knowledge.

Estimates vary, but there are likely around 1,300,000 people who work in the formal urban waste collection system (paid by local governments or businesses—their main job is the collection and transport of waste, selling recycled materials is only a secondary revenue stream) and another 2,500,000 in the informal sector (paid mainly by the sale of collected materials). Residential waste collection in Chinese cities is undergoing rapid change. Already, many cities have had to retrofit neighborhood transfer stations to enable both horizontal and vertical waste compaction (illustrating the increase in packaging materials, plastics and paper). Larger "central transfer stations" will become increasingly important in China. Most cities over 1,000,000 will need to build these facilities over the next 5 to 10 years as they respond to growing waste volumes [19].

4.0 ISSUES AND CHALLENGES

Solid waste collection is a vital part of human development. It is a big issue all over the world and management mainly collecting it efficiently is a big challenge. If solid waste is not managed properly, it will create a lot of problems in near future. Main issues and challenges in collecting solid waste efficiently are described in this section.

4.1 Rapid Urbanization

As the world hurtles toward its urban future, the amount of municipal solid waste (MSW), one of the most important by-products of an urban lifestyle, is growing even faster than the rate of urbanization. As

a result of high life standard, people are producing more waste. It has been seen countries with rapid urbanization tend to produce more waste than the other. If they fail to collect these generated wastes efficiently, it will create great nuisance not only for these countries, but also for the rest of the world. Therefore, emphasis should be given to efficient collection and disposal of waste with urbanization.

4.2 Population Growth

The increase in population growth and urbanization are making most of the cities densely populated with large housing complexes to accommodate this increased population. This increase in household indirectly increases the waste generate per household as well as the total waste accumulated in the locality. Managing these wastes efficiently has become a challenge for the local governing bodies [36]. Hence, to limit waste generation, population growth must be checked.

4.3 Effect of Global Warming and Climate Change

Increased global warming and change in climate have a lot of effect on waste collection. Increase in temperature decreases the productivity of indoor and out-door workers by increasing their water demand. Irregular precipitation occur flood or heavy rain. Due to this roads get damaged interrupting the proper collection of waste. Reducing global warming and climate change is a big challenge. But it needs to be given attention not only for the environment but also to increase workers' productivity.

4.4 Reduction of waste

Reducing the solid waste is a great challenge for every country. With the decrease of waste generation, total budget allocated for its collection and environmental pollution will be decreased. But waste generation increasing pattern can be seen all over the world regardless of developed and developing countries. In many countries three 'R'- reduce, reuse and recycle have taken as solution. However, if waste cannot be collected separately and efficiently, it will not be possible to decrease generated waste. This increasing waste will cause tremendous problem in the near future.Therefore, more number of recycle bins should be introduced to make it easier to collect waste more efficiently.

4.5 Environmental Pollution

Issues regarding waste collection in developed countries are now mainly concerned with introduction of the technique of collecting waste with environmental pollution as less as possible.More fuel consumption and environmental pollution due to collection vehicles has increased with waste increment. Again, indiscriminate dumping of solid waste and failure of the collection system in a populated community for two or three weeks would soon cause many aesthetic and environmental problems [20]. Therefore, steps must be taken for optimizing waste collection to avoid pollution and climate change or global warming.It can be done by introducing smart bins.

4.6 Lack of Technical Knowledge4.5 Environmental Pollution

It is seen that developed countries have knowledge, technology, welfare, willingness and infrastructure for decreasing the environmental impacts while poor and developing countriesare lack of this and is expensive to import, authorities don't have enough knowledge for deciding about the best regulations, environmental protection problems etc. [4].Developed countries have abundance of capital and expensive skilled labor and they devise capital-intensive waste management system in order to save labor cost. Whereas developing countries have cheap, unskilled labors. So they need low-cost, labor-intensive solution which will create employments and reduce poverty [32].The challenge is to make authorities learn the proper knowledge and to apply it to overcome issues regarding efficient waste collection.

4.7 Lack of Proper Collection Route4.5 Environmental Pollution

Low-income countries do not have proper road for transportation. Illegal slum resulting unpaved or narrow street is a common scenario that makes it difficult for garbage trucks to visit those areas. Even if collection vehicles enter, most of those break down due to harsh condition of the road and stands idle in garage for a long time waiting for repair [32]. Uprooting these illegal slums is a challenge. Again, waste collection in an optimized route will result in the optimization of waste content and waste collection issue can be reduced.

4.8 Budget Allocation

Solid waste management frequently suffers more than other municipal service when budget allocations and cuts are made. The provision of collection and disposal services for municipal refuse is not perceived as deserving higher priority.There is not yet such technology that can be operated in a low budget. Therefore, a good amount of budget needs to be allocated irrespective of developed or developing countries.

4.9 Risks to Workers

Occupational health and safety studies from various low-income and high-income countries show that waste collection is a particularlydangerous occupation. Workers are vulnerable to traffic

accidents, puncture wounds,chemical burns, back injuries, and respiratory illness from high concentrations ofbio-aerosols and other particulates. Regular medical examinations and preventative vaccinationsare recommended, as well as protective working uniforms that include boots,gloves, covering clothing, visibility vests, and dust masks[19]. But in countries where economy is not strong and people's lifestyle is beyond standard, it is a financial challenge to ensure these instruments to the collectors.

4.10 Peoples Attitudeand Awareness

There is a general issue in solid waste collection is that efforts of people employed to collect, dispose and recycle wastes are rarely appreciated regardless of developed and developing country [37].Moreover, people are not always aware of the environmental effect of proper waste management. Sometimes they are very indifferent about recycling or reuse of waste.

5.0 CONCLUSION

This study reviewed the overall solid waste generation and their collection process. It is forecasted that the developed nation or high-income are trying to find environment friendly ways to collect or decrease waste generation. However, the developing countries or low-income nationswhich are urbanizing rapidly with a great amount of waste generation still lacking on proper knowledge and solid waste collection process. Hence is putting environment and livelihood in threat. This study presents the issues and challenges on the knowledge generation and existing solid waste collection process. It is suggested that if the information are being maintain, then in future, a risk-free, less polluted, sustainable environment in terms of solid waste monitoring and management could be maintained. With all these effort, this review will help to develop and design the government or solid waste agencies policy for the improvement of clean and green society.

Acknowledgement

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