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Drivers to Sustainable Plastic Solid Waste Recycling: A Review

Bupe G Mwanza^a, Charles Mbohwa^b

^aUniversity of Johannesburg, Po Box 170114 Doornfontein, Johannesburg 2028, South Africa

^bUniversity of Johannesburg, Po Box 170114 Doornfontein, Johannesburg 2028, South Africa

Abstract

Waste recycling is a livelihood for the marginalized society in the developing economies and it is not surprising to find recycling of municipal solid waste (MSW) been carried out. Plastic waste is a waste type in MSW yet a number of challenges still exist in managing this waste type. A literature review was conducted to identify the key drivers to sustainable development of post-consumer packaging plastic waste recycling systems in developed and developing economies. A number of articles focusing on drivers or factors influencing sustainable management and recycling of solid waste and municipal solid waste were reviewed. Further analysis of the results indicated a number of drivers from the economic, environmental and social aspect as drivers to sustainable development of recycling systems for post-consumer packaging plastic solid waste.

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1. Introduction

Rapid and unplanned urbanization leaves municipalities largely overwhelmed when it comes to the collection and disposal of increasing amounts of waste [1]. Municipal solid waste management continues to remain one of the most neglected areas of urban development and this has called for sustainable means of management. It is characterized by a number of waste types and of these are plastic solid wastes (PSW).

Plastics have become an integral part of our lives because of the many properties that they possess. The drivers to such growth is their low density, strength, robust, design and fabrication capabilities and low cost. As a result of such properties, plastics are not only used as packaging materials, they are also used in automotive and industrial

applications. Their usage in a number of applications including preservation and distribution of food, only makes it reasonable to find a considerable amount of PSW in the final stream of municipal solid waste (MSW). While plastics are found in almost all MSW categories, it is important to identify factors that influence the proper ways of managing such wastes. Despite having a number of positive properties, plastics contribute a variety of demerits from the waste management perspective.

Recycling is considered as one of the best options in the solid waste management hierarchy to reduce the impacts presented by end of life (EoL) and end of use (EoU) post-consumer packaging plastic wastes. Other than contributing to municipal solid waste management by diverting materials which have economic value from the main waste flow, thus reducing quantities of waste to be collected and disposed [2, 3], recycling provides the opportunity to use recovered plastics to manufacture a new product [4,5]. For these reasons, recycling provides opportunities for recovered polymers to cascade through multiple stages throughout their lives hence contributing to sustainable manufacturing. Recycling is recognized as the “most environmentally sound” strategy for dealing with MSW following only the preventive strategy of source reduction and reuse [6, 7]. [8] indicated that recycling could be categorized as the most positively received type of solid waste management practice and as an essential part of sound waste management. It is clearly a waste management strategy but can also be one current example of implementing the concept of industrial ecology whereas in a natural ecosystem there are no wastes but only products [9].

In developing economies, the issues of municipal solid waste management remain a challenge especially the recovery of end of life (EoU) post-consumer packaging PSW for recycling. Despite a number of studies having been conducted on recycling plastics, a majority of these have used the life cycle assessment (LCA) to evaluate the environmental, economic and social impacts of the processing and recycling chain [10, 11]. Other studies have either assessed solutions for reducing the damage coming from the most impacting phases during the production of recycled polyethylene terephthalate (RPET) fibre-based panel for building heat insulation [12]) while others have compared the environmental and economic impacts of different recycling technologies or have evaluated the different methods of reprocessing reclaimed PET resins (e.g. bottle to fiber) [13, 10]. These studies are useful in suggesting the sustainable technologies and higher –efficiency reprocessing of reclaimed resins.

In contrast, few studies have analyzed the drivers to sustainable post-consumer packaging PSW recycling. [14] conducted a review on plastics recycling: challenges and opportunities. The findings of the research indicated recycling as one of the strategy for end of life (EoL) waste management of plastic products. Further [15] conducted a literature review on recycling and recovery routes of plastic solid waste and the review indicated that, it is important to consider recycling and energy recovery methods in plastic manufacturing and converting facilities. Both [14] and [15] conducted a review on plastic recycling by describing the processes of plastic recycling and the challenges and opportunities of such processes. However [15] indicated that it is important to consider recycling methods in plastic manufacturing and converting facilities. In our research, plastic recycling is considered as an aspect of sustainable manufacturing as recovered plastic wastes are used to manufacture new products which would have otherwise been manufactured by using virgin material. As a result of recycling, sustainable management of material is implemented.

In our work, drivers are mechanisms that can significantly impact development in sustainable recycling (manufacturing) of plastic wastes. Therefore the literature review is basically aimed at identifying the drivers that can enhance the development of sustainable recycling systems for post-consumer packaging plastic wastes. The objectives of the research are; to identify the drivers influencing the development of sustainable systems for managing and recycling plastic solid waste or municipal solid waste (MSW). Second we analyze the drivers or factors influencing the development of sustainable systems for plastic solid waste management and recycling into economic, environmental and social aspects. In doing so, we will expand on the works that have looked at plastic solid waste management from the life cycle assessment since most life cycle assessment on plastics focus on the economic and environmental aspects, [16, 17, 18].

2. Literature Review

In developing countries, recent urbanization has increased the concentration of people resulting in accumulation of waste that needs to be properly managed and disposed [19]. With this in mind, it is necessary to determine the drivers that influence solid waste management specific to each country context [20]. Absence of the relevant drivers in solid

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