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Implementation of (Zero-Waste) Concept in Solid Waste Management in Al-HILLA City

Hind Mufeed Ewadh[1], Eqbal Hussain[2]

1,2Babylon university- Centre of Environmental Research and Studies, Iraq

Corresponding author: 009647729446604, Email: hindewadh@yahoo.com

Abstract

Solid waste has become one of the worldwide environmental issues because of the expanding in the population, fast urbanization, affluent economy and the rise in community living standards that significantly accelerated the solid waste generation in the world which drive the experts in solid waste management systems to apply a (Zero waste) concept that they found it important to reduce the amount of solid waste in different ways. Zero waste is a concept for challenging solid waste issues in our society through stimulating economic creation, utilization, ideal optimum recycling, and resource recovery. In this study, the management of solid waste was discussed and focusing on zero waste practices to decrease the amount of solid waste gathered in the landfills and diminished the contamination happened from solid waste, zero waste strategy was discussed to implement in Al-Hilla city as a sample to apply this idea with the challenges to change to transform traditional waste management toward zero waste. "Zero Waste" is a good solution to minimizing the solid waste amount. However, lack of awareness in the community toward solid waste management but can be applied even in the simplest way.

Keywords*: Zero Waste, Solid waste management,zero waste strategy, Recycle,*5R

Concept.

1. Introduction

Municipal solid waste (MSW) is defined as unwanted materials or wastes mostly generated from households and municipal activities [1,2]. The amount of solid waste in landfills contributes to extraordinary levels of environmental problems, such as water and soil contamination through leaching of heavy metals, and air pollution by emission of greenhouse gases [3,4,5]. Recycling and composting bins are becoming more widespread in cities and municipalities, most of the waste created is still sent to landfill. For example, in Canada, the overall diversion rate of household waste (e.g., mixed paper, plastics, glass, metal, and organic matter) is estimated to be around 33% [6; 7], while the rate for the U.S. household is around 35% [8].This rate is under the potential diversion rate of household waste which could be recovered and recycled with a ratio of 75–90% [9].

Waste management is still a big challenge for administrations and governments. These difficulties and challenges include community awareness is still generally low, particularly the people who are trading in the market, the absence of trash assortment offices, and the limited number of counselling workers so that the campaign intensity is still relatively low [10]. As the world races toward its future, the amount of municipal solid waste (MSW) is becoming considerably quicker than the rate of urbanization. It was estimated that in 2012, globally about 3 billion urban residents generated waste at a rate of 1.2 kg per person per day (1.3 billion tonnes per year). By 2025 this will probably increment to 4.3 billion residents generating producing about 1.42 kg/capita/d of MSW (2.2 billion tons for every year) [10]. The developing countries are quick-moving from farming-based countries to industrial countries.

As indicated by[11] the generation of solid waste is expected to increase consistently along with economic growth if a lifestyle of mass production, consumption, and disposal is continued. Recently, there have been developing worries about the environmental effects related to solid waste management, as well as the increasing costs that solid waste management entails. Wrong solid waste management causes air, soil, and water contamination. The solid waste materials block drainage systems, causing floods during stormy seasons particularly in urban districts, therefore, the reduction in the quantity of generated waste materials minimizes their impacts on the environment. The solid waste issue should either be matter must either be recycled or reused. At the point when these options are When these alternatives are unsuitable, waste must be burned with energy recovery and just as a last choice, should landfills be utilized [12]. Open dumping of waste prompts numerous ecological issues including ground and surface water contamination, odours, disease, and others [13].

Solid waste management (SWM) is one of the poorly services in developing countries like Iraq paralleled with constrained resources, increasing population, rapid urbanization, lack of proper planning, inadequate data regarding solid waste generation and collection increased the solid waste problem. Waste is arranged on day by day bases in Babylon Governorate by burning only despite the fact that there are a few efforts for beginning recycling projects. Decision-makers need to outline arrangements that think about numerous objectives and systems to reduce the solid waste issue [14]. There is a various of solid waste hierarchy to treat the solid waste with less cost and contamination as appeared in Figure 1 that shows the means of solid waste treatment.

Iraq is one of the most populated Arab nations with a population exceeding 32 million. Rapid economic growth, high populace development, increasing individual income and religious conflicts have led to the worsening problem of

solid waste management problems in Iraq. Iraq is evaluated to create 31,000 tons of solid waste each day with per capita waste generation exceeding 1.4 kg every day [15]. Baghdad alone produces more than 1.5 million tons of solid wastes each year. Hence, a strategic solution must be found to decrease the amount of solid waste and limit the contamination brought by the solid waste. One of the most up to date arrangements depends on maximizing the understanding of solid waste hierarchy by preventing from sources, reuse, recycle and recovery stages and applying these stages in the realistic life, this solution is named (Zero waste concept). Zero waste means no unnecessary and unwanted waste from a product at any stage of its life cycle [16]. It not only encourages recycling of products but also aims to restructure their design, production, and distribution to prevent waste emerging in the first place [17]. The concept has attracted much public attention since the late 1990s and huge numbers of associations worldwide have embraced the concept of zero waste by setting an objective of zero waste disposals to landfills.

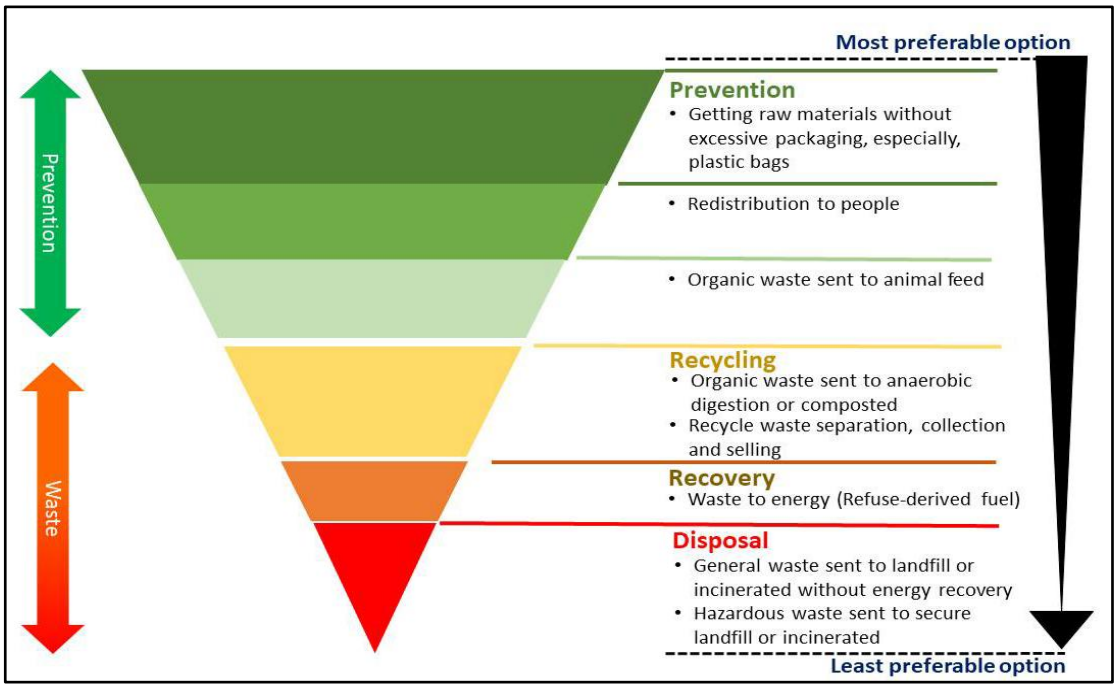

Figure 1: Solid Waste Management Hierarchy [18]

A policy of Zero Waste (ZW) is a policy that can be defined by the Zero Waste International Alliance [19] designing and managing products and processes systematically to eliminate the waste and materials, conserve and recover all resources and not burn or bury them, ZW is about waste prevention through sustainable design and consumption practices, optimum resource recovery from waste and not about managing waste by incineration or landfills [20]. A study conducted by [21] clarified the Zero waste activity and the techniques for execution components towards zero waste, beginning from the pre-information

assortment, information investigation of the waste created and how the mindfulness is significant component for reducing solid waste, the action extends to study the responsibility of shopping with the methods of the reducing solid waste, many elements going through this action that ends with full data and full assessment towards zero-waste concept. Study conduct by [22]shows that Germany reached zero landfills in 2009, which means a 100% municipal solid waste recovery from landfill and it is the first of the EU countries to archive such a zero-landfill goal.

The aim of this study was conducted to find out how far the concept of Zero Waste can be implemented in Al-Hilla city for better handling of waste. This study applied the three-tiered Identification, Classification, and Evaluation to study the effect of zero waste implementation in Al-Hilla city.

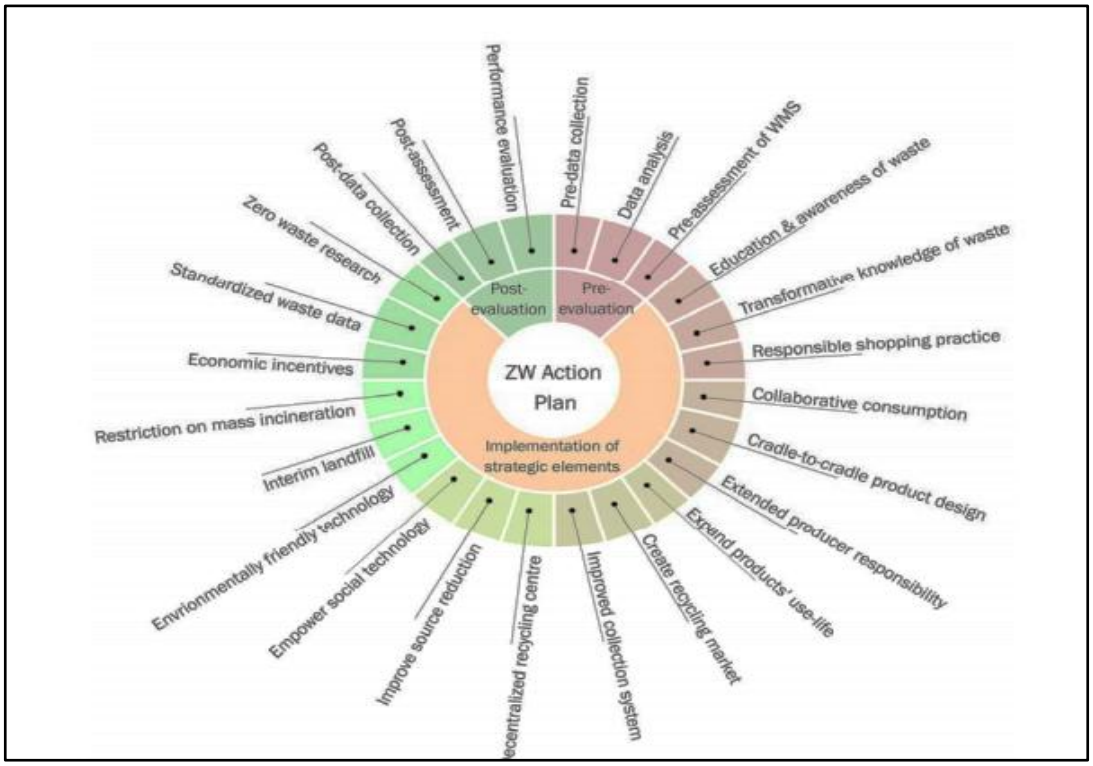

Figure 2: Steps in the zero waste (ZW) action plan [21]

2. Methodology

There is many steps towards applying zero waste concept in Al-Hilla city, first the amount of solid waste generate in Al-Hilla city was estimated and the highest portion was detected**,** second stage is by define the main component of zero waste and how to expand the awareness of it between the community, third step is expected the reduction in solid waste disposal to landfill. Figure 3 illustrate the steps of applying the zero-waste concept.

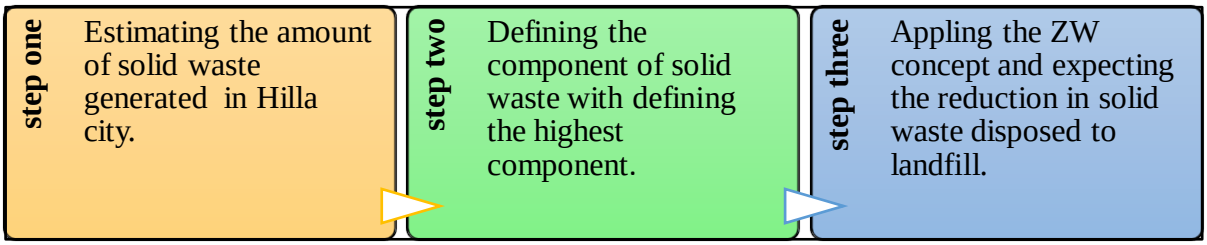

Figure 3: Steps of zero waste concept applied in this study

2.1 Quantities and classifications of Solid Waste Generated in Babylon city

In Babylon Governorate, the existing landfill sites do not satisfy the international criteria like that adopted in developed countries. In 2013, the solid waste generated in this governorate was 483,221 tons and the solid waste generation rate was 0.67 kg/capita/day. The budget spent on this procedure in that year was 15,894,716 USD 23 [15]. Sources of solid waste in Babylon Governorate can be categorized [23]:

1. Household waste.

2. Commercial waste from shops and markets dispersed throughout the governorate.

3. Industrial waste, from the industrial companies.

4. Agricultural waste resulting from the extensive agricultural in Babylon Governorate.

5. Social waste from educational institutions such as schools, colleges, etc.

6. Waste from general services such as hotels, restaurants, coffee shops and casinos

Table 1: Solid waste generation rate for 2013and 2030

Parameters	Values
PP(2013)	807,777
FP(2030)	1,332,930
SWGR 2013 (kg/capita/day)	0.82
SWQ (2030) (Tonne)	472,474
SWCQ 2020-2030 (Tonne)	4,300,864
Volume of waste in 2030 (m3)	674,963

Cumulative waste volume from 2020 to 2030 (m3)	6,144,091

PP: present population; b FP: future population; c SWQ: solid waste quantity; d SWGR: generation rate of solid waste;SWCQ:cumulative quantity of solid waste [24].

The amount of solid waste generate in Babylon for 2013 was 662.4 tons/day which is less than other places comparing with the amount of disposed MSW in Erbil landfill site (ELS) in Iraq, Pulau Burung landfill site (PBLS) in Malaysia and Palestine were 2000 tons/ day, 1800 tons/day, and 3605 tons/day, respectively [25,26,27].The composition of the solid waste in Babylon city were documented and it was found that the organic waste has the highest ratio between the others with a ration of (55%), for glass (5%) and for the plastic (8%) and the others ratios are illustrated in Figure 4.

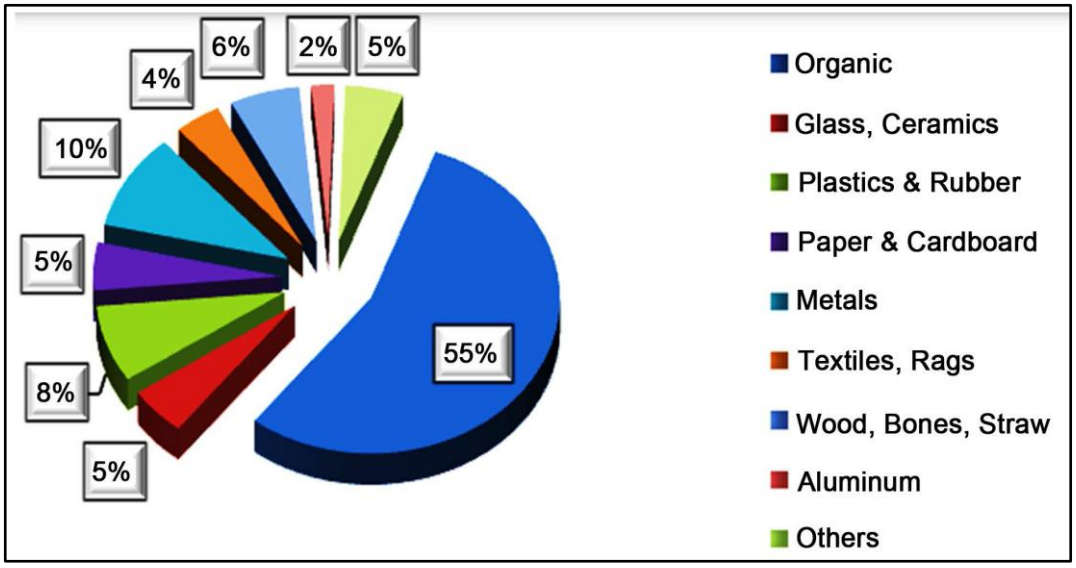

Figure 4: Composition of municipal solid waste in Babylon Governorate [28]

2.2 Implementation 5R concept towards Zero waste

The second stage of applying zero waste concept is to maximize the awareness of solid waste management between the community starting from houses, schools, hospitals, shopping centre, universities and all active facilities that generate solid waste. 5R concept is consist from five principle, arranged in hierarchy with a wide base for the most wanted principle and the narrow base related to the most unwanted principle concept[29].The 5R conceptis a major principlefor zero waste based from the zero-waste alliance in Europe:

*Refuse-Rethink-Redesign

* Reduce and reuse

* Preparation for reuse

*Recycling-composting- anaerobic digestion

*Recovery (Waste-to-energy)

*Residuals management (biological treatment and stabilizing landfilling)

*Disposal

2.3 Distribution of bins with 3D illustration

One of the additional option of the concept implementation is by distribution bins as a control and bins have 3 diemention drawing that illustrate the type of waste to increase the attraction for putting the solid waste in the right place as shown in Figure 5. Each house must be provided within two bins at least, one bin to separate the organic waste and paper waste since both types are degradable and the other for other waste type since there deficiency in solid waste management in Iraq.

Figure 5: Applying the 3d illustration to the bins [30]

3. Results and Discussion

Applying ZW by applying a 5R concept will reduce the amount of solid waste dumped in the landfill and in a result, the advantages found are like advantages to the community by changing the way of life. By highlighting the first step which is more desirable to apply by refusing to buy any unwanted items with a high amount of packing material and in result high amount of solid waste generated. Also, rethink before buying items by selecting items with less material to be refused and the most important step is redesigning the business goods with less packing materials so in results less materials to be refused to the landfills and will reduce the toxicology and significantly minimizes the risks to public health.

Reduce and reuse is the second step in the zero-waste hierarchy. Reusing will increase in job offers by increasing benefits from the benefits of reused material and raise economic and financial benefits. More steps are shown in Table 2 that explain the simplest steps of applying the ZW concept since the developing countries have a lack of solid waste management.

Table 2 Steps of applying the ZW in simplest ways in Babylon city

Concept	Steps	Benefits
Refuse	✓ Learn to say NO to any item you don't need ✓ Refuse to buy any items with extra packing. ✓ Refuse to use plastic bags and straws.	✓ The first step of conducting ZW concept is done. ✓ The amount of plastic waste will reduce and no additional treatment will be needed.
Rethink	✓ Rethink before buy any item if really needed or not. ✓ Buy items made from recycled materials.	✓ This step will wake up your awareness towards the things you buy. ✓ Build a sustainability culture to decrease the amount of waste.
Redesign	✓ Select the items having less materials to refuse, like redesigned shapes, volume, packing and materials. ✓ Redesign also can be applied at any stage of the item process.	✓ Less items in the solid waste stream. ✓ Increase the ability for reuse items for other purpose. ✓ Innovate other ideas for manufacture the items.
Reduce	✓ Reduce as much as you can the items enter the solid waste stream. ✓ Reduce buying items that are not necessary	✓ Waste reduction activities must be prioritized. ✓ Tracking the waste data. ✓ Awareness will be

	and select items with less packing and will less materials to refuse to the landfill.	increased to handle the waste.
Reuse	✓ Use reusable water bottles. ✓ Reuse the big plastic bags for shopping. ✓ Rehome the items for second hand use market.	✓ Amount of waste will less by 70% if items been reuse in the right path.
Recycling	✓ Separate the items that can be recycled in different bins like paper, plastic. ✓ Increase the workshops and training for the recycle concept between community.	✓ Save money. ✓ Offers jobs opportunities for recycled factories. ✓ Using the recycled items instead of virgin material will reduce the cost of item manufacturing and save the environment.
Composting	✓ Gather the food waste, paper waste, wood, garden waste, coffee ground, tea and compostable plastic. ✓ Select a backyard place situatable for placing the compost container with cover. ✓ Maintain the composting by moving the compounds until it become dry and brown then fed the garden.	✓ Aerobic digestion will break-down the organic matter and used as soil fertilize and rich the soil. ✓ Notice that we must be sure the decomposition process is complete before using compost; otherwise, microbes in the compost could take nitrogen from the soil and harm plant growth.
Disposal	✓ Separate the residual waste in different	✓ The untreated waste will be dump in the

	types of bins like for paper, food, and plastic bins.	landfills and can be used as structure land after closing the landfill. ✓ The items refused to the landfill supposed inter process of regeneration not incineration.

ZW application has many advantages to the environment such as decrease of waste generation and its negative effects; extension of the useful life of sanitary landfills; increased efficiency in utilizing raw materials and reduction of virgin raw material extraction; reduction of the emission of greenhouse gases; opportunity to produce energy through wastes and/or the sale of carbon credits; decrease of energy consumption because of the higher eco-efficiency of the production and recycling processes; increased environmental protection; and reduction of the use of toxic materials in the products. Industries and their stakeholders have their part in ZW by improved efficiency and productivity – producing more with less; improved product design to extend life cycle; increment of companies' competitive potential through customer satisfaction and increased reliability; encouragement to the elaboration of a sustainable chain of suppliers; and industrial symbiosis practices, where companies provide their wastes to other companies and vice versa.

On the other hand, the pavement of the roads considered also a significant point to the trucks of the solid waste collections. A proportion of 55% of solid waste generation in Babylon city was organic waste which comprises from food waste, green waste, food-soiled paper, wood waste and landscape and pruning waste, compared with the weight percentage of food waste found in the USA, Denmark, the UK, Poland, and Ireland varies from 9 to 36 %, which is smaller than found in Hilla city [31]. This amount of organic waste can be utilized to create methane gas for power generation or used in local as fertilizer for the soil by breaking down the organic waste by anaerobic decomposition (because of the absence of oxygen) and produces methane quickly. Mention that the refuse-rethink-redesign must be applied before any procedure to decrease the waste as possible by increasing the awareness in restaurants, houses, school. For metal waste, its proportion was 10% and plastic waste was 8% which can be completely reused and utilized as primary material instead of using virgin one and in result lower cost to form new items. All the waste can be decreased to (0 %) if right arrangement was applied as shown in Figure 6 that shows the expected results of applying ZW concept with present of 5% represented for the waste amount

disposed to the landfill, for the organic waste was (2.75%), plastic waste (0.4%) and for the glass waste (0.25 %).

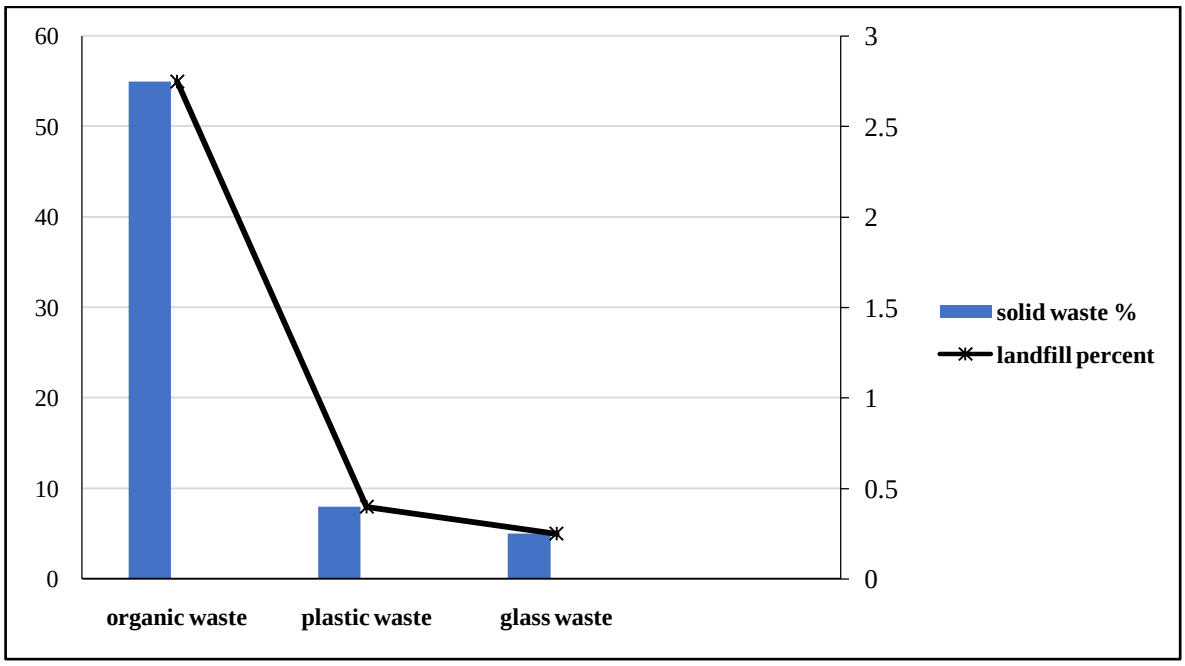

Figure 6: Reduction in solid waste amount with landfill percent

4. Conclusions

The rapid increase in waste generation is putting the worldwide under huge threat, the issue of global warming and climate change and its effects on human has led people to think about sustainable natural resources. The local government must build up laws and rules to limit the solid waste to decrease the contamination brought by solid waste, the awareness must be expanded beginning from the kindergarten and the elementary schools.

Waste in Iraq isn't isolated or have any treatment, no awareness about the solid waste management in Iraq, hence the Zero waste idea is important applied to reduce the amount of waste buried in landfills, in results, reduce the emissions and contamination produce from the solid waste, the utilization of ZW concept can limit the waste covered in landfill to 5% just rather than 100% to landfill dump.

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