



Evaluating the Performance of 3Rs Waste Practices: Case Study-Region One Municipality of Tehran

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Abstract

This paper presents an examining household participation in 3Rs waste practice and the reasons of non-participant residents in 3Rs waste practice of the Region One Municipality of Tehran, Iran, and provide suggestions for improving the MSWM system through formulation of local 3Rs waste strategies, particularly on separation at source and recycling activities of the residents of Region One Municipality of Tehran, Iran which will help to promote the sustainable waste management. A household survey using a self-completing questionnaire was done in Region One Municipality of Tehran. A sample of 486 households participated in the household survey. The study revealed that only 26% of the households take part in waste reduction activities and 20% in practice reuse and 29% in separation at source. The traffic lights coding system model for ranking performance 3Rs-Reduce, reuse, and recycle, the participation rate of households in the case study area in 3R performance ranked between low/medium categories. Overall, survey results in the case study area about barriers to household's participation in 3Rs waste practice are categorised under the three main categories, behavioural, awareness and situational barriers.

Keywords: Iran; Tehran; 3Rs; Municipal solid waste management

Introduction

Rapid growing waste generation rates due to increasing population growth and rapid urbanization, caused changing lifestyle and consumption patterns are resulting in high costs of waste management system include of waste collection, transportation, disposal, separation of solid waste at the source [1]. At present issues like as public awareness raising, increase of reduce; recycling and reuse, depletion of landfill space, and institutional and legal barriers are unresolved problem in Tehran city.

The Global Waste Management Goals (GWMO) launched by UNEP and ISWA in year 2015 focused on ensuring a substantial reduction in waste generation through prevention and the 3Rs (reduce, reuse, recycle) by 2030 as one of the main goals [2].

However, there are several major limitations remained in the way of municipal solid waste management improvement such as material recovery and recycling as the best options for managing urban waste. Therefore, the extraction of landfill gases to produce energy, or incineration projects or the production of derivate fuels to be recycling or recuperation operations will decrease UN habitat 2010.

Improper municipal waste management may result in serious urban, sanitary and environmental problems such as unpleasant odour, risk of explosion in landfill areas, as well as groundwater contamination because of leachate percolation [3].

It seems one of the best solutions to support sustainable waste management are through the application of the 3Rs policies and effective implementation. The varying levels of success of the 3Rs practice around the world have led to significant amount of research being focused on explaining the variance observed in community participation in waste practice specially focused on recycling and

composting rates and to improve the methods employed in household waste management.

This article describes overview of 3R concept as a conceptual framework. The major highlights are about the waste management hierarchy. This waste hierarchy draws attention to the technical as well as the social aspects of solid waste management. It has been discovered that while the waste hierarchy dominates the agenda in cities of developed countries, it receives little attention in cities of developing countries. These countries still grapple with technical tasks and participatory approaches for reach to 3R option goals. The success of integrated waste management based on 3R approach depends on the households' participation. In this article three main subject of 3R were posed to respondents to find out their manner toward 3R options.

The objectives of the study were examining household participation in 3R waste practice and the reasons of non-participant residents in 3R waste practice of the Region One Municipality of Tehran, Iran. The results of the study will provide inputs into the formulation of local 3R waste strategies, particularly on separation at source and recycling activities of the residents of Region One Municipality of Tehran, Iran which will help to promote the sustainable waste management.

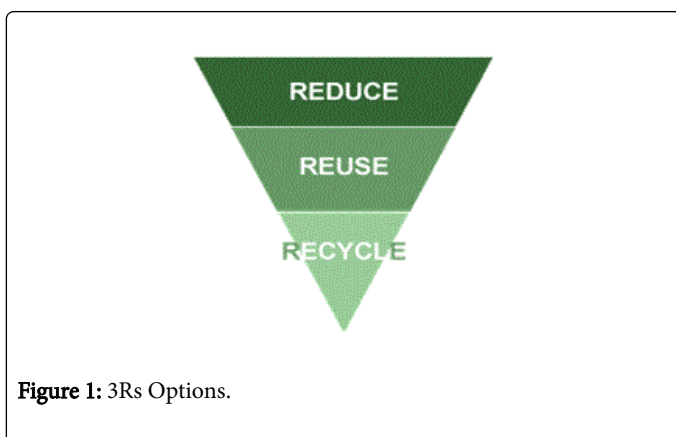
3Rs Concept

The issue of 3Rs has become a significant policy approach for sustainable development with the priorities placed on it by the World Summit on Sustainable Development (WSSD) and one of its key outcome documents-the '10 Years Framework Programme on Sustainable Consumption and Production'. Also, Para 22 of the WSSD Joint Plan of Implementation specifically endorses the 3R policy approach as a means to achieve sustainable consumption and production [4].

EU 2010 defines waste hierarchy order as a waste management behaviour which relates to recycling, reusing and reduction [5]. The EU waste policy legislation aims to move waste management up the waste hierarchy with emphasis on 3R policies, through community participation and awareness raising in the following 3R policies, adopted in developed worlds briefly introduced.

In order to reduce the total amount of waste that goes into the land fill, it is important to first reduce the volume of waste generated, then reuse existing materials and finally recycle materials. This "3R"-reduce, reuse and recycle-is a fundamental concept for waste management [6]. 3Rs practices comprises different measures and skilful techniques to minimize the volume of discarded waste materials that was generated to dispose out [7]. Waste management hierarchy is the internationally accepted guidelines for waste management practice, given emphases to reduce waste at source, where waste can; it has been prevented, reuse should be explored, Recycle option will be encouraged if the waste cannot be reused.

In the following Figure 1, "3Rs" options briefly explained.



Reduction

The first option in waste hierarchy is strict prevention of waste generation by implement source reduction strategies in all production activities. This is the prevention principal "avoidance of waste". Waste prevention is closely linked to improving manufacturing methods change of manufacturing designs such as reducing packaging [8] and influencing consumers so that they demand greater products and less packaging [5]. Many Member States are running awareness-raising campaigns to educate the public and encourage consumers to demand goods that produce less waste and drive the creation of a more resource-efficient market.

This can only be achieved by effective waste prevention at source which include adoption of suitable practices, adjustments in the usage of raw materials, as well as in technology and production processes. At the domestic level, source reduction can be done not necessarily by adopting a high technology but only by making suitable decisions in the management of the household [9] Such as change of consumption pattern and lifestyle by running awareness- raising campaigns to educate the public and encourage consumers to demand goods that produce less packaging and drive the creation of a more resource-efficient market [5] and compact garbage by producers such as reducing the amount of packaging by individual practice include of use of plastic bags, reducing the use of plastic and paper plates, cups and plastic utensils, and consume more reusable items or use of more

recyclable materials, Earlier studies indicate that nearly 20 per cent reduction in waste generation is possible through simple housekeeping measure that requires no or marginal investment. Proper design and packaging of products with minimum volume of material and longer useful life can reduce the waste considerably [10].

Reuse

The next best option for SWM is re-use and this encompasses the utilization of an item after its primary use either for a purpose similar to that which it was planned or for a completely new one. Reusing items can be by repairing, selling or donating these items to charity and community groups, and therefore this can reduce waste. Reuse is preferable to recycling since the item doesn't need to be reprocessed. In addition to environmental consideration, sensitive reuse schemes can have important social and cultural benefits [11]. This is exemplified in the reuse of bottles (of beverages) or shopping plastic bags from stores [9].

Reusing materials multiple times or for another purpose can also save on solid wastes. Some examples of this include, refilling a water bottle rather than buying a new one; reusing newsprint as a paper towel to clean items and soak up liquids; using re-useable cloth napkins instead of paper napkins; reusable cups instead of paper cups; and reusing grocery bags for garbage collection.

Recycling

Recycling is another waste management strategy in developed countries. The recycling process includes collection, segregation and processing of waste with productive value as such inorganic fractions of MSW (paper, metal, plastic, glass materials) may be recycled [9].

3Rs performance around the world

Solid waste management practices in developed countries progressed from 'no-system' to an increasingly centralized 'municipal system'. According to this approach, the municipal authorities are the main actors in the field.

Most developed countries are implementing solid waste management strategies based on 'waste hierarchy' by emphasizing re-use and improving the quality of products that can be recycled. The hierarchy of MSWM is said to be an internationally accepted and practical concept in many countries throughout the world especially in developed countries [5]. This policy shift away from landfilling has significantly increased the use of medium priority waste handling methods, which were historically more prominent due to resource scarcity but dropped to single digit percentages in Europe during the first half of the 20th century [12].

Many similarities exist between the historical SWM development trajectories of industrialized countries and the current trajectories of developing countries. Many cities in lower income nations are experiencing similar conditions to those of the last century in high income countries such as, increasing urbanization and socioeconomic disparities, inadequate provision of sanitary and environmental amenities, social exclusion and inequalities related to existing SWM systems, and high levels of morbidity and mortality linked to inadequate sanitation, waste disposal, and water supply provision were common then as they are today, particularly in poorer urban neighbourhoods in lower income countries [13].

Common concerns regarding mainstreaming 3R policies among developing countries are urbanization, inequality, and economic growth; cultural and socio-economic aspects; policy, governance, and institutional issues; and international influences, and lack of expertise and budget have complicated SWM in developing countries [12]. so very little instances of promoting formal, 3R based solutions for waste crisis exist. Considering these challenges, polices should be shifted from relatively simple practice such as waste prevention rather than starting from more advanced engineering concept and high cost activities [14]. Recycling in Europe has rebounded to 25% or higher [12] and in Austria and the Netherlands this rate reaching as high as 60% [15].

In Australia, for instance the recycling rate is high and is increasing, with 99% of households reporting that they had recycled or reused some of their waste within the year 2002, up from 85% in 1992 [16]. Recycling rate in Germany and Austria for example, go beyond 25%, with and Brazil having material recovery rates as high as approximately 41% [17,18]. For most of such advanced countries, recycling is typified by kerbside programs through which collection and segregation of recyclables are carried out. the European Union has targeted to reach recycling rates of at least 50% in all over Europe by 2020, while the front-runner countries are around 65% and the EU average is 39% as of 2013 [17].

Developed countries in Asia like Japan, South Korea, Taiwan, and Singapore ultimately aim for the elimination of landfills from their systems. In these countries, SWM systems have become stable through a variety of legal measures supported by central government financial support. Likewise, in these highincome Asian countries, their citizens are highly aware of their responsibilities and making SWM a common practice in their daily life. Recycling rate in Republic of Kora reported Very High (>90%), and in Singapore High (>70%) as the pioneer developed countries in East Asia Region [14].

Regarding reuse, this could be exemplified in the reuse of bottles (of beverages) or shopping plastic bags [9]. The rates of reuse in developed countries are very high, in some developed countries such as Japan, Sweden, Belgium and Denmark, and Finland, the index of reuse of solid waste is over 90% [19]. For example, in Finland, 95% of the soft drink, beer, wine and spirit containers are refillable, and in Germany, 73% are refillable [16].

Moreover, reusing start to play a conventional practice in developing countries. In China for example, in order to avoid using plastic bags, the Chinese government has created a policy since 2008, to pay for the plastic bags, and encourage using reusable bags. So, all supermarkets in China sell the plastic bags which pushed people to reduce using it, and provide reusable bags to use instead the plastic bags. Another example in developing countries, refillable glass bottles are still widely used, and families routinely take the empty bottles to grocery stores when they purchase beverages. If someone doesn't bring an empty bottle when purchasing a beverage in a refillable bottle, must pay a deposit equivalent to the cost of the bottle. This encourages the return of reusable bottles, which is in parallel encouraging the reuse principle. A very successful example of waste reduction are community waste organizations initiatives in the United Kingdom. Some schemes have reduced average waste disposal from 800 kg to 250 kg per household per year and recycling rates between 47% and 52% have been achieved [12].

Literature review purpose was to compare 3Rs performance around the world. Results revealed policies differ among countries owing to

each country's particular local condition or political strategies. Like as the composition of MSW which is differs for different countries and regions and plays a significant role in determining and designing an appropriate technology and facilities for waste treatment, the waste hierarchy is difficult to implement because solid waste managers in industry and government have little control over production decisions that could influence higher-level priorities, such as waste prevention and minimization [20].

Also, most of the published research has focused on high-income countries [1]. Even though data is generally lacking in the waste sector of developing countries with only a few research conducted like as 3Rs (reduce, reuse, recycle) policies to transition from waste management to resource management. So, for the above-mentioned reasons, and issues such as lack of universal definition and indicators and limited information accessing concrete statistics for comparing rate of 3R performance in both developed and developing countries are impossible [21].

In Iran as a case example of this study, a considerable amount of research work on solid waste management has already been conducted in Iran particularly have been carried out to assess citizen participation in recycling such as evaluating citizen attitudes and participation in solid waste management that focused on households' waste separation-at-source [22], study on plastic recycling in Tehran, the citizen participation in separation of waste, by assessment of different influential factors [23], factors influencing householders' waste separation behaviour in Tehran city [3]. However, no study to investigate the rate of 3Rs-Reduce, reuse, and recycle performance by households in Iran.

Research Methods

The analytical framework is built around the concept of 3Rs. The survey method adopted through household questionnaire surveys which aimed to obtain the feedback of residents within the case study area with corresponding reference to the performance of 3Rs options. Taking into account a sample size of 486 households, the questionnaires were distributed throughout the Region One Municipality of Tehran. A semi-structured survey questionnaire with closed and open-ended questions was used in this study.

First, households' participation in 3Rs options measured by nominal scale, Yes/No questions [24] and then, in the second part of the questions peoples who answered yes, selected how they did their practice and those answered No, in qualitative part of the questions, mentioned the reasons for non-participation.

The data was analysed both qualitatively and quantitatively. The statistical methods used in this research consisted of descriptive statistics of frequency count and simple percentage analysis [25] for quantitative result. The qualitative results were extracted from answers and obvious duplicates removed. Second, the unsorted data were allocated into three core categories, shown in Table 3.

For interpretation of the obtained results, the traffic lights coding system from low to high used to rank performance 3Rs-Reduce, reuse, and recycle in this study [2]. This scale consists of the following structure: Low 0-9%, Low/ Medium 10-24%, Medium 25-44%, Medium/ High 45-64%, High 65% and over.

Results and Discussion

Households participation in 3Rs performance

Three main questions were designed to get understanding about respondents 3R option waste practice. These questions also asked the respondents to give reasons for not taking part in 3R performance practices. The rate of participation of respondents' in 3R activity mentioned in Table 1. Households take part in 3R performance practice as follow: 26% for waste reduction, 20% for practice reuse and 29% for separation at source. The traffic lights coding system, which is used to rank performance of 3Rs-Reduce, reuse, and recycle in this study, the participation rate in the case study area, ranked between low/medium categories [2].

3Rs options practice	Frequency	Percent
Practice 'reduce'	120	26%
Practice 'reuse'	94	20%
Separate wastes at source	136	29%

Table 1: Households' participation in 3Rs options practice.

Practice reduce of wastes

The rate of households' participation in practices reduce of wastes indicated 26% of respondents gave attention to waste reduction and 74% believed that it was not possible for them to reduce the amount of waste they generated. Second part of the question regarding waste reduction, those who responded Yes to this question explained how they reduce waste with two actions, compact trash and buy products with less packaging. The findings indicate that the majority of them, 48% mentioned they compact trash before disposal and 36% stated they chose to buy products with less packaging items (such as reducing on the packaging from where the purchases were made), and 12% select both items. Table 2, presents the responses to the possibility of reducing the amount of wastes.

Waste reduction tips	Frequency	Percent
Compact trash	57	48%
Buy products with less packaging	44	36%
Both options	14	12%
No answer	5	4%
Total	120	100%

Table 2: Waste reduction tips.

Practice reuse (through Municipal services)

The rate of household's participation in waste reuse was 20% via Tehran municipality reusable goods donation programme (137 Numbers) and the rest, 80% are via other traditional manner of households. Only 10% of respondents mentioned putting out for collection by regular garbage collectors. Table 3 shown waste reuse tips in traditional manner by households in the case study, area in the second part of the question regarding reuse, those who responded 'No' to this question explained how they treat to reusable goods.

Other waste reusable tips	Frequency	Percent
Donate to poor people by yourself or to charity centres	124	30%
Sell or exchange with other stuff with local buyers	26	7%
Put out for collection by regular garbage collectors	38	10%
Keep at home for future use	124	30%
No answer	11	3%

Table 3: Waste reuse tips in traditional manner.

Recycling or separate at source

The rate of participation in sorting was 29%, while 71% did not participate in recycling. About one-third of the respondents participated in sorting waste. In the second part of the question regarding separation at source; those who responded "YES" to this question explained how they delivered recycled material. 52% of households were engaged in sorting out, and then delivered to the municipality recycled collection trucks, 41% delivered to the municipality recycling kiosk (buy back centres) and only 7% sell to informal recyclers or exchange with other goods.

The second part of the question designed for those who answered 'Yes' to the first part of question 26. The respondents were asked to identify the recycling methods they used. The results are presented in Table 4, deliver to municipality-recycled collection trucks and deliveries to municipality recycling kiosks are generally considered the most favourable methods of household.

Recycling tips (methods)	Frequency	Percent
Deliver to municipality recycled collection trucks	73	52%
Deliver to municipality recycling kiosks	57	41%
Sell to informal recyclers or exchange with other goods	6	7%
Total	136	100%

Table 4: Waste recycling tips.

Barriers to households' 3Rs performance

Understanding households' reasons for not participating is important to improve participation in the 3Rs performance. Respondents addressed many key problems for no participation in 3Rs practices. The qualitative data from the questionnaire in the case study area are categorised under the three main groups and summarized in the Table 5.

Variable of Individual Action Barriers	Frequency	Percent
Behavioural Barriers		
Not in the habit in lifestyle	103	22%
Lack of Time (too busy to do their tasks about 3Rs practices)	75	16%

Forget to do my task	46	10%
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Table 5: Barriers of households' participation in 3Rs performance.

Results indicated that although weekly recyclable collection service existed, residents did not separate wastes because they had no time and facilities to dispose their separated wastes or local people does not pay attention in source separation benefits because they are not motivated by authorities.

The study found that inadequate logistics hinder households' participation in 3Rs option practices in the case study area. Some people explained the inconvenience of storage both inside and outside the house for disposal of waste and recycling. One barrier for citizens in separating waste at source was that the kitchens are small and there is not enough space to store the recycling bin. Respondents complained about delays in waste collection and transportation by the private contractor and inadequate recycling provision by the municipality (wanted better and more convenient infrastructures for recycling). This means that the municipality didn't provide user-friendly mechanisms to increase reuse, recycling and waste reduction.

Study finding regarding situational barriers to individual waste practice is in line with findings [26], it has been reported that collection, transfer and transport practices are affected by improper bin collection systems, poor route planning, lack of information about collection schedule and, insufficient infrastructure. The recycling behaviour was not only influenced by knowledge about local recycling services, but was also determined by the availability of a kerbside recycling scheme and availability of space for storing the recyclables.

In the same line with study finding, Inconvenience is considered as one of the greatest barriers to recycling [27]. Overall, survey results in the case study area about barriers to household's participation in 3Rs performance agree with the findings of Post who discovered that in order for individuals to have responsible behaviour act to reduce waste production or practice sustainable disposal methods, barriers relating to knowledge, access, and convenience must be minimized.

Conclusion and Recommendations

The historical forces and mechanisms that have driven the evolution of SWM in high-income countries can provide insight about how to move forward in developing country.

contexts Implications for the improvement of the households' participation in in 3Rs performance in Region One Municipality of Tehran in particular and in Tehran City in general, followings issues must be put into consideration

- Governments should introduce and enforce the laws, regulations and national policy frameworks which strengthened and expanded to shift the emphasis from end-of-pipe approach to an integrated waste management based on 3Rs options.
- At local level integrated waste management strategy and action plan for municipalities, especially in developing countries needs to be developed and implemented.
- There is a needing to organize household's behavioural and attitudinal change plan and programs to disseminate knowledge and skills based on the social and cultural background of the case study area-UNESCAP terms this phenomenon as "Trash is Cash."

- Municipality should facilitate public participation by making adequate provision for recycling facilities and infrastructure for example more buy-back centres should be created.
- The householders must be sensitized and educated through mass media for achieving 3R approach for integrated solid waste management.
- Available best practice especially from developing countries in the areas of policy, institutional set up, financing mechanisms, technology and infrastructure, roles and responsibilities of waste actors, and political will and awareness would faster the 3R approach improvement process.

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