CHINA'S EXPERIENCE IN MUNICIPAL SOLID WASTE MANAGEMENT - LESSONS LEARNED FOR ALGERIA

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ABSTRACT

Recently, by observing Algerian market, we find that the Chinese products are cornering this market. Since the living standards have risen in Algeria, as well, the purchasing power has increased too. Therefore, this led to the increasing amounts of municipal solid waste in Algeria. And it reached 10 million tons in 2011 and it is projected to reach 18 million tons by 2030. In Algeria, most of waste is treated by open-dumps, uncontrolled dumps and landfill. However, all these methods cause air, water and soil pollution, which is harmful to human health, plants, and animals. Moreover, most developed countries seek to manage waste with minimum negative impacts and provide the natural resources for future generation by reducing the use of these natural resources and reuse and recycle it as most as possible through applying 3R principle (reduce, reuse, recycle). In addition, China has effective experiences in 3R principle. Since Algeria benefit from the consumption of Chinese goods, and as China has efficient waste management; hence, Algeria also can benefit from China's experiences in this area. In this context, this research paper will present different methods using in municipal solid waste management in China especially in reducing, reusing and waste recycling. Through analyzing the different methods and policies used by Chinese government in managing waste, this research can conclude some healthy methods and ways to reduce and get rid of Algerian waste.

Keywords: Algeria, China, Waste, Management, Reduce, Reuse, Recycle.

INTRODUCTION

The importance of a good environment for a business may be greater than the availability of the wealth, because this latter will simply come if the conditions are appropriate (Thomas, 2003). Nevertheless, environmental problems are always political ones because they can have a great impact on the health, wealth, and even the life and death of members of the general population. Moreover, most developed countries seek to manage waste with minimum negative impacts and provide the natural resources for future generation by reducing the use of these natural resources and reuse and recycle it as most as possible through applying 3R principle (reduce, reuse, recycle). Recently the Chinese products are cornering Algerian market. In addition, China has effective experiences in 3R principle. Therefore, since Algeria benefit from the consumption of Chinese goods, and as China has efficient municipal solid waste management (MSWM); hence, Algeria also can benefit from China's experiences in this area.

LITERATURE REVIEW

There have been a series of published papers and books which reviewed the trend of waste management including waste collection, recycling and disposal in China. World Bank (2005) talked about waste management in China by providing some issues and recommendations. Moreover, Visvanathan & Trankler (2009) made a Comparative Analysis of MSWM in Asia. In addition, Guilberto & Shigefumi (2010) discussed MSWM and issues in south east and East Asian countries. They included municipal solid waste (MSW) composition, laws, regulations, and standards for MSW in China. Qi et al (2006) analyzed the situation of MSWM in China. Furthermore, Dong et al (2010) discussed the status, problems, and challenges of MSWM in China, and they talked about waste collection and disposal methods. Xu et al (2010) made an overview of MSWM in China. They showed that since the late 1990s, the amount of MSW collected has been largely decoupled from economic growth and incineration has become an increasingly widespread treatment method for MSW. They identified and discussed four major challenges and barriers related to China's MSWM, and they proposed an integrated management framework to improve the overall eco-efficiency of MSWM. Bouanini & Dadene (2013) analyzed and evaluated the commitment to social and environmental responsibilities in Chinese companies. And they used a survey based on Chinese companies located in Nanchang city in China. Hence, they found that there was a great importance concerning the environmental responsibilities in those companies through reducing waste, reducing energy conception, reducing resources consumption and reducing pollution emissions.

There are some literatures about MSWM in Beijing city such as Xiao et al (2007), Li et al (2009), and Qu et al (2009). Among the studies in Shanghai there are Hong et al (2006), Edmonds (2008), and Zhu et al (2009) who described a waste generation and composition analysis, and they provided a comprehensive review of MSWM in Pudong new area, Shanghai. Shan and Carlos (2004) discussed the waste management literacy and waste reduction preferences of domestic waste generators in Guangdong cities. In addition, Chung and Poon (2001) compared MSWM in Guangzhou and Hong Kong. Moreover, other authors have addressed MSWM in different cities in China such as: Chongqing "Yuan et al (2006)," Hangzhou "Zhao et al (2009)," Tianjin "Geng et al (2007), and Zhao et al (2009), and" Tibet "Jiang et al (2009)."

Currently, the 3R Principles: Reduce, Reuse, Recycle became increasingly implemented in many European countries, USA, Japan, and other developed and developing countries. There are similar studies in China and other countries such as: Hongpin et al (2009) characterized the recyclable resource recycling system according to a survey in Suzhou city in China, and they reviewed the strategy and policies for promoting and regulating recycling. In addition, Mohan et al (2011) analyzed environmental benefits of steel recycling in the world. And they presented a discussion on policy issues that could enhance the use of scrap in steel-making. Ming et al (2012) showed the effects of uncontrolled e-waste recycling, and they considered that it can generates persistent toxic substances and releases such compounds into the air, bottom ash, dust, soil, water and seriously adverse effects to local workers and their families. Bouanini (2013_a) analyzed how the 3R principle (reduce, reuse and recycle) can help to achieve sustainable development. And she depended on a survey in a university environment in China in order to evaluate and analyze people's behavior and willingness to participate in the 3R principle. Thus, the results showed that although the analyzed sample was educated people but there was a lack in the participation of the 3R principle. As well as there was a lack in environmental knowledge.

There are very few literatures about MSWM in Algeria, among them there are: Garfi et al. (2009) applied general criteria for human development to the study of different waste management solutions in Saharawi refugee camps in Algeria, and they tested the feasibility of a decision-making method developed for application under particular conditions in which environmental and social aspects must be considered. Sefouhi et al (2010) pointed trends and problems of MSWM in Batna city in Algeria and they showed the prospects for a sustainable development. In addition, Bouanini (2012) assessed the management of MSW for well-being fulfillment in Algeria. And she found that there were a poor culture with respect to the 3R Principles (reduce, reuse, recycle) in Algeria. However, the Algerian government was trying to make rules and regulations in order to manage MSW. And they applied the principle of "polluter pays" by creating some laws and executive decrees towards more sustainable environmental management. Moreover, Bouanini (2014) analyzed people's behavior towards reducing MSW in Bechar city in Algeria. And she found that people help for reducing the use of plastic bags, but they don't participate in reusing principal. In addition, there is a lack in knowledge and culture of recyclable products. And people in their majorities were affected by both cultural and political factors to minimize waste, and the rest didn't comply with these factors.

RESEARCH METHODOLOGY

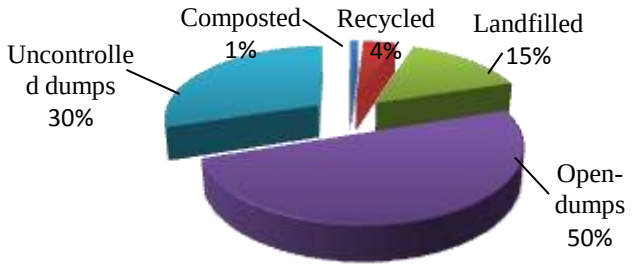
In order to profit from China's experience in MSWM and learn some lessons for Algeria, this research will use a descriptive study to show the situation of MSWM in both countries Algeria and China and then it will discuss some legislations and laws made by Algerian government and Chinese government to conclude some recommendations for both countries and especially for Algeria.

RESEARCH DISCUSSION

Managing MSW in Algeria

The Algerian MSW contains a high proportion of Organic, plastic, and paper/cardboard. However, glass and metal make very low proportions. And 14% of MSW contains other types (Kehila et. al, 2010). In 2009, the quantity of MSW generated in Algeria was estimated at 8.5 million tons/year. And each Algerian in urban areas generates about 0.7kg of solid waste daily (Kehila et al, 2010). According to the 2011 report of the National Agency for waste, the quantity of MSW reached more than 10 million tons in 2011. The report pointed out that the volume of MSW collection coverage was estimated at 85% in urban areas and 60% in rural areas. The National Agency of waste estimated that annual production of MSW will reach 12 million tons in 2015, and 17 million tons in 2025 (Nathir, 2011). And the most of waste generated is treated by open-dumps and uncontrolled dumps. The following figure "1" shows the percentages of the final destination of MSW in Algeria.

Figure 1: Final Destination of MSW in Algeria



Source: *updated from Kehila et. al, 2010.*

Algerian Legislation for MSWM

In recent years, local and regional governments are responsible for developing and implementing MSWM plans, which are important to ensure the quality of life for citizens (NEST, & EMAS, 2007). Actually, international participation and leadership in waste management and processing is essential. Indeed, without the involvement and commitment of the leaders of countries and industries, a global approach to waste management will not be achieved. Environmental standards and certification programs provide a specific framework for an overall, long-range strategic approach to environmental policy, plans, and actions as part of a cross-functionally integrated environmental management system (Eberhard & Hans, 2002).

Since 2002, Algeria sought to create a financial action to fight pollution and minimize it, for that it issued tax act including the collection of MSWM (Razik, 2007). According to the Environmental Directorate of Bechar city, tax garbage removal has been significantly upgraded by Law n°: 01-21 in December 22, 2001, and it applies annually fees collection of households for the benefit of municipalities where there is domestic waste collection service, based on all property. The amounts of this tax are as follow:

Table 1: Tax on the Collection of Household Waste

amounts (Algerian Dinars)	Source
500-1000	Residential Use (Household Dwelling)
1,000-10,000	Commercial Use and Professional & Vocational or something like that
5,000-20,000	Land predisposing to establish camps
10,000-100,000	Industrial Use, Commercial Use, and Craft Producing Larger Quantities of Waste than those mentioned above

Source: *Michel et. al, 2003*

In 2002, Algeria has developed a National Action Plan for Environment and Sustainable Development (NAPE-SD). This plan offered a vision of the future that Algeria engaged in to invest in environmentally sustainable development. In addition, improving the health and quality of life of citizens was a central objective of the NAPE-SD. As well as, the establishment of an integrated MSWM remained a priority and urgency (MATE, 2002).

In the same year, Algeria has launched MSWM National Program (PROGDEM). The national program for integrated solid waste management (PROGDEM) was developed by the Ministry of Spatial Planning and the Environment since 2001, which focused on a new strategy. This was based on the precautionary principle, prevention; the polluter pays principle, the principle of producer recovery, and the role of information and awareness of the citizen. It involved firstly the 40 major Algerian cities. The main actions involved in PROGDEM were: development and implementation of municipal waste management plans; development of site landfilling; promotion of recycling activities and waste recovery; introduction of new forms of management; gradual adjustment of tax collection of household waste and improving the rate of recovery; and awareness, training and education. The program has made it possible to develop master schemes for more than 900 out of the existing 1541 municipalities; launch the building of nearly 100 CETs and a similar number of controlled landfills; build about ten sorting centers and to launch the rehabilitation of crude dumps.

Moreover, Algeria created the National Plan for Management of special waste. This plan was developed through the contribution of the European Commission through the EC- LIFE program and administered by the World Bank METAP. It concerned the management, control and disposal of waste. Algerian government has created some laws and executive decrees for MSWM appropriately. And the table "2" bellow shows these laws. The law 01.19 of 12 December 2001 is the basic legislation for MSWM. It is concerning the conduct of solid waste and it stipulates the need to develop a special strategy to re-manufacture of solid waste, through the adoption of the principle of selective screening. But this experiment did not circulate in the entire country, and without achieving the results expected, and this is due to the lack of environmental awareness among the citizens and also the lack of publicity and guidance by the responsible authorities (Hossin, 2013). The key institution for MSWM is the Ministry of the Land Use Management and Environment (MATE), which is assisted by the National Agency of Solid Wastes (AND) created by the Decree no 02-175 of May 2002. A system for the collection, recycling and valorization of solid wastes (ECO JEM) has been established by the Decree no 04-199 in 2004. Funding structures include the National Agency of Development and Investment (ANDI), which finances projects on waste collection in cities (mainly in Algiers), the National Agency for the Support of the Employment of Youth (ANSEJ), with finances the creation of small private enterprises of solid waste collection and transport and the National Fund for the Environment and De-pollution (FEDEP), which finances solid waste management projects (DG Environment & European Commission, 2006).

Table 2: Algerian Legislative Laws for MSWM

laws and executive decrees	**the related field**
law No.01-19	The management, control and disposal of waste.
Law No: 01-21	Tax garbage removal
law No.03-10	The protection of the environment in the context of sustainable development.
executive decree No.02-175	The creation of the national waste agency (AND)
executive decree No.04-410	The general rules for the development and operation of waste treatment facilities and the admission of such waste at these facilities.
executive decree No.07-205	The modalities and procedures for the preparation, publication and revision of the scheme of municipal household and similar waste management
executive decree No.02-372	Packaging waste
executive decree No. 04-199	The modalities for the establishment, organization, operation and financing of the public system of treatment and recovery of packaging waste.
Executive Decree No. 04-210	Defining the procedures for determining the technical characteristics of packaging destined to directly hold food products or items meant to be handled by children.
Ministerial Order	Laying down the technical characteristics of plastic bags meant to directly hold food products.

Source: *Kehila et. al, 2010*

MSWM in Algeria has remained till today in the public sector domain. The private sector's contribution is limited and often comes in the form of informal activities involving the anarchical recovery of recyclable waste in public dumps. The authorities have decided to promote incentive schemes to encourage the participation of this sector (establishing micro-enterprises) in the activities related to waste management through contracts and concessions. The activities of collection, sorting, recycling and landfill operation may be open to outsourcing.

Even if, the Algerian legislation considerably improved the practices of management of waste, total volumes of waste continue to grow at very high rates (Sefouhi et. al, 2010). However, To establish a system for delegating environmental services, the authorities have offered training programs for the benefit of local authorities in order to improve managerial competencies (technical staff and elected officers) in MSWM (Kehila et. al, 2010). Therefore, Algerian legislation should focus more on reduce, reuse, and recycle to minimize the amount of waste.

Managing Waste in China

The amount of MSW increased every year in China, and it reached in 2010 about 250 million tons of MSW, where 158 million tons were generated. However, China is creating more laws and regulations to reduce and control the quantity of MSW. According to China Association of Environmental Protection Industry, MSW output in China will reach 179 million tons and 210 million tons in 2015 and 2020 respectively. And according to Lianghu et al (2014), in 2010, 66.94% of MSW was sent to sanitary landfill, 16.2% was incinerated, 1.29% was composted, and the rest was dumped at random. China has several household incineration factories, including the one in Shanghai "Minhang," which is supposedly the largest one in China. The facility is designed to have a daily garbage handling capacity of 3,000 tons and generate around 270 million kilowatt-hours of power per annum. Landfill in China occurs at three categories: Open dump or open landfill, Semi-controlled or operated landfills and Sanitary landfills. However, in recent years, Chinese cities are reducing landfills and making more interest to incineration by building waste incinerators, aiming to burn the trash while producing electricity (Bouanini, 2013_b).

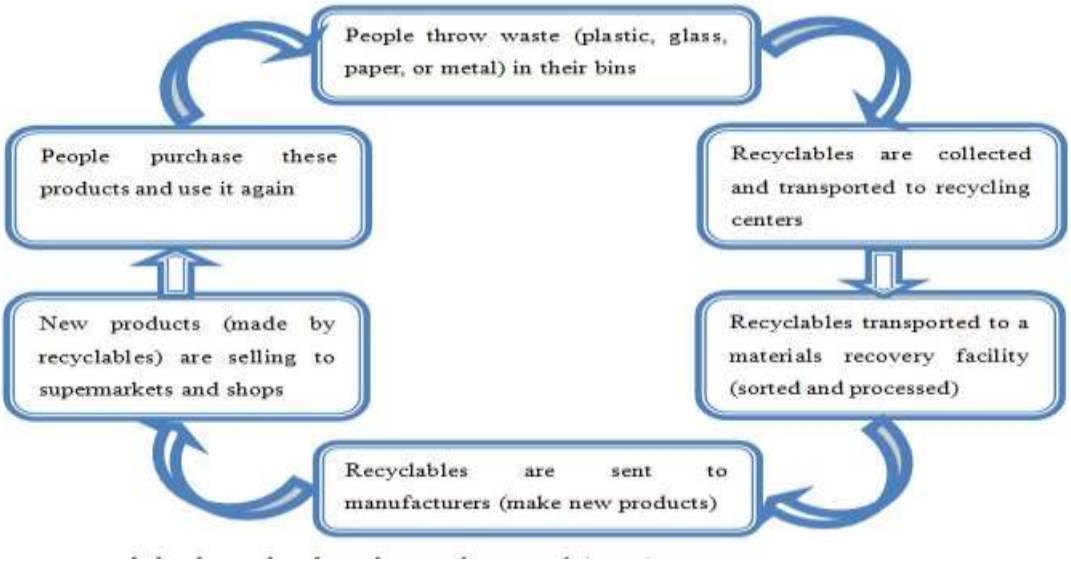
Generally, MSW collection in the major cities in China is carried out as a two-tier system: primary and then secondary collection. Primary collection involves storage and transportation of the waste from households to local collection points. And this is achieved by various means. Secondary collection includes storage and transportation from the local collection points to points of treatment, and disposal, and is undertaken as a municipal responsibility. Waste collection services vary enormously between Chinese cities and even within different parts of cities. Since 2000, residents in China are advised to place their waste in bags and deposit their garbage in the appointed garbage bins outside the residents' house for collection. And then the waste is transported by truck to a transfer station. And this system is usually carried out by a community or business entity in China (Dong et al, 2010). According to the law, the collection of MSW is managed by the competent administrative department of construction under the State Council and the competent administrative department of environmental sanitation of the local people's governments. Furthermore, collection of municipal waste is under the direction of corresponding local departments known as the Environmental Sanitation Bureau, City Appearance and Environmental Sanitation Bureau, Municipal Administration Commission, etc (Guilberto & Shigefumi, 2010). In order to encourage the separate collection of waste at source, China provides separate waste bins for recyclable and non-recyclable waste conveniently placed in streets and parks.

Figure 2: Separate Waste Bins for Recyclable and Non-Recyclable Waste

Reduce- Reuse- Recycle became more active in China in natural resource development and uses. By the end of 2005, there were 23,512 enterprises engaged in the 3R industry in China (Liu et al. 2006). Although the state did sponsor some kind of recycling industry, the private and informal activities constitute the most important mode of recycling. That is because the casual waste picker relies on this recycling to resell the materials. Based on the Ministry of Environmental Protection of China, informal recycling goes in four steps, (1) individuals separate the wastes to their smallest unit, (2) it is brought to community-based waste collection centers, (3) it is then brought to centralized garbage centers, and (4) it is sent to a plant.

In 2008, China's recycling rate was lower than other countries, because the secondary materials' market in China was affected by several factors such us; the value to the recycles. China's target is to realize 50% recycling of waste paper by 2030, over 38 million tons of waste paper could be diverted from disposal. Hence, China can realize this target if people help in connecting the recycling circle (see figure "3").

Figure 3: The Recycling Circle



Source: *Bouanini (2015)*

In January 2008, the Chinese government banned shops from giving out free plastic bags, and asked consumers to use baskets and cloth bags instead in an effort to reduce pollution. "White pollution" is a reference to the color of many of the bags given out stores; however, it is an eyesore problem in much of China (Jeffrey, 2008). The reuse centers are also emerged in

China. An example, in Nanchang (Jiangxi province in China) the government provides a big and clean center for second hand products such as refrigerators, chairs, desks, TVs etc… to encourage the reuse policy (Bouanini, 2012).

Chinese Legislation for MSWM

Under the environmental policies, Chinese government has identified a set of laws and regulations to find a suitable solution in order to reduce waste and to regulate the behavior of humans and economic organizations. According to Lianghu et al (2014), At the Third National Meeting on Environmental Protection held at the beginning of 1989, it was decided to enforce the following eight regulations: ‘‘Environmental Impact Assessment’’, ‘‘Three Simultaneities’’, ‘‘Discharge Fee for Industrial Pollutants’’, ‘‘Objective Responsibility’’, ‘‘Quantitative Evaluation on Integrated Management for Urban Environment’’, ‘‘Emission Permit’’, ‘‘Centralized Pollution Control’’, and ‘‘Timed Pollution Control’’. Based on the experiences of industrial pollution control, the importance of Cleaner Production was recognized from the early 1990s. The emphasis of environmental protection began to turn from ‘‘End of Pipe Control’’ to control throughout the whole production process, from (discharge) ‘‘Concentration Regulation’’ to ‘‘Emission Total Control’’ (mass loading control), from separate pollution source control to centralized control. These symbolized the change in the direction of policy to guide industrial pollution control. In the same period, several official documents were formulated: ‘‘Ten Countermeasures for Environment and Development’’, ‘‘The Twenty-First Century Agenda’’, and ‘‘Environmental Protection Action Plan of China’’, etc., illustrating the adoption of the strategy of a sustainable development (Lianghu et al, 2014).

With respect to the challenges brought by the rapid economic development from 1990s, legislation and regulations in China have been enhanced quickly. According to Samantha (2007), FINPRO (2008), The Ministry of Construction of P.R.C, and the Ministry of Environmental Protection, China has comprehensive set of policies governing MSWM, The current policy system can be divided into three different levels, namely: regulations, laws and documents issued by the State Administrative, regulations and documents issued by related Ministries of Central Government and local laws and regulations issued by local governments State Level.

Laws for MSWM include Environmental Protection law, Management Regulations on Municipal Appearance and Environmental Sanitation and the law of the P.R.C. on Prevention and Control of Solid Waste Pollution. Related ministries and commissions have formulated local regulations and rules to carry out state level laws and regulations on the local level. Furthermore, new legislation recently published includes an Environmental Impact Assessment Law, a Cleaner Production Law, a Circular Economy Promotion Law, a Prevention Law, and a Nuclear Pollution Law. The existing Air Pollution Prevention and Control Law were enacted in 1995, and its revised new law was already announced at the end of 2000 (Lianghu et al, 2014). The law of the P.R.C. on Prevention and Control of Solid Waste Pollution issued in 1995 is the basic and most important law with regards to MSWM, which formulated basic requirements for dumping, cleaning up, collection and transportation, 3R Principle (reduction, reuse and recycling) and disposal. This law was revised in December 2004, and the new version became effective on April 1st, 2005 (Bouanini, 2013_b). Moreover, the technical policy on pollution prevention which was effective from april 27th, 2006, it promoted the eco-design, and set forth the guiding principles of “3R” and “polluter pays principle” (Lin & Yang, 2012). In addition, some related regulations and standards have

already been formulated by the State Council, the Ministry of Construction, State Environmental Protection Administration, State Development Planning Commission, State Environmental Protection Administration, Ministry of Finance, and the Ministry of Environmental Protection … Some examples are:

- City appearance and environmental sanitary management ordinance 1992.
- Regulations regarding municipal residential solid waste 1993.
- Law on prevention and control of environmental pollution caused by solid waste of PRC 1996.
- Comments on the promoting of industrialization of municipal waste-water treatment and MSW treatment 2002.
- National catalogue of hazardous wastes 2008.
- Catalogue of solid waste forbidden to import in China, catalogue of restricted import solid wastes that can be used as raw materials in China, catalogue of automatic-licensing import solid wastes that can be used as raw materials in China 2008.
- Imports of MSWM practices 2011…etc.

CONCLUSIONS AND RECOMMENDATIONS

Every single human being living on this planet has a part to play in reducing, reusing and recycling, as well as in protecting this precious world, and making it greener, less toxic and more inhabitable. China has preliminarily set up its environmental protection system, although not very completed. The basic laws and regulations of the People's Republic of China on Environmental Protection are very important for guiding to prevent and control MSW pollution. However, all country members should follow these laws and regulations for helping to reach these goals. Moreover, the government is seeking to reduce the amounts of MSW by encouraging reduce, reuse and waste recycle to reduce the quantity of MSW generated for landfill and incineration.

Despite the increasing in MSW in Algeria, however, the government is trying to manage this waste effectively. And it provides large sums of money for the environmental sector. MSWM is an important environmental problem in Algeria, because the greater part of the generated waste is disposed of at uncontrolled dumps and open dumps. And there is almost non-existent culture of composting and incineration plants as well as recycling rate is also very low in Algeria. Therefore, the government is introducing some laws and regulations to enhance recycling and to improve landfilling. Unfortunately, finding a recycling bin is extremely hard in Algeria, which may explain the tendency of the inhabitants to dispose of all their waste together. And this is probably because the result of the lower living standard of residents in Algeria compared to other developed countries, as well as the fact that their environmental awareness is also correspondingly lower.

The 3R principle is a great way to protect our environment and stimulate our economy. However, the most important factor that can help to protect the environment, as well as encouraging waste minimization is the education. Through formal education starting with kindergarten to primary schools, middle schools, high schools, and universities. There is a need for environmental education which is very important by providing students with important life lessons through engaging on 3R principle that promote responsible and sustainable environmental behaviors. As well as educate the whole community about the benefits of waste reduction, reuse and recycling through television programs. Other than being more aware and cautious of all our actions, we should also seek to integrate recycling

practices as well as reducing and reusing habits into our everyday lives and our day-to-day activities so that it becomes a norm rather than an option. Local governments should make more incentives to increase 3R principle's participation by providing householders with financial incentives which can increase participation and recycling rates and by supporting the concept of people paying less is they recycle more.

The municipalities charge fees for waste collection but it doesn't charge for waste disposal. However, in reality disposal requires more technical expertise and efforts. Therefore, applying disposal fees can encourage people to minimize waste generated. And government should develop laws to pay a tax for each of throwing waste in public places because this can create unpleasant odor and unattractive appearance of piles of uncollected solid waste along streets all those can discourage tourism.

We can help to realize a closed-loop for recycling if everyone brings the waste (e.g. paper, plastic, glass) to recycling centers. Then this waste will be sold to factories, where they use that waste to make new products and people will buy the new products and use then recycle them and the whole loop starts again. In addition, Reduce, reuse and recycle are also a form of patriotism, because we are helping our country to save money and reduce our dependence on other countries for raw materials. We should make use of items as much as possible and encourage the consumption of second hand products. Moreover, we should use more reusable products such as the reusable bags which made of cloth or jute, and reuse the plastic bags as possible. As well as, avoid purchasing heavily packaged products and minimize packaging to minimize the amount of waste or reuse packaging where possible.

The Algerian municipalities should provide waste bins conveniently placed for the people to deposit waste. However, people should be aware to keep these waste bins safety. And it is better to provide garbage containers in all neighborhoods with the allocation of special containers for recyclable materials and other for non-recyclable materials, and so as to facilitate the separation process from the source and thus facilitate the recycling process. Moreover, the government should promote recycling by facilitating the operations of waste sorting and create factories for recycling in different cities. As well as encouraging the recycling industry. For encouraging reuse principle, Algerian government should consider establishing reuse centers in each city, and it should encourage also the exploitation of waste and turn it into organic fertilizer for farmland. As well as government should encourage incineration to produce energy.

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