
*Assessing the Management of Municipal Solid Waste for Well-Being Fulfillment
in Algeria*

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Abstract

Municipal solid waste is positively associated with economic development, population, urbanization and affluence. The Algerian municipal solid waste contains a high proportion of Organic, plastic, and paper/cardboard, as well as low ratios of glass and metal. All these types of wastes are recycled or treated by incineration, landfill or other methods. However, the best way is waste reduction from the source. Unfortunately, there is a poor culture with respect to the 3R Principles (reduce, reuse, recycle) in Algeria. Wherever, the collection and treatment of municipal solid waste is usually a municipal responsibility. In order to apply the principle of “polluter pays”, the Algerian government has created some laws and executive decrees towards more sustainable environmental management.

Keywords: *Municipal Solid Waste, Algeria, 3R Principles, polluter pays Principle, Sustainable Environmental Management.*

الملخص

ترتبط النفايات الصلبة البلدية بشكل ايجابي مع التطور الاقتصادي، السكان، التحضر، و الثراء. إن النفايات الصلبة البلدية الجزائرية تحتوى على نسبة عالية من العضوية، البلاستيك، و الورق/ الورق المقوى، و كذلك نسب منخفضة من الزجاج و المعدن. و يتم تدوير جميع هذه الأنواع من النفايات أو معالجتها بطرق الحرق، أو المكب أو عن طريق غيرها من الوسائل. و مع ذلك فإن تقليل النفايات من المصدر يعتبر أفضل طريقة. و لكن للأسف هناك ثقافة فقيرة فيما يخص المبادئ R3 (التخفيض، إعادة الاستخدام و إعادة التدوير) في الجزائر. حيث ان جمع و معالجة النفايات الصلبة البلدية عادة ما يكون مسؤولية البلدية. و من اجل تطبيق مبدأ "الملوث يدفع" انشأت الحكومة الجزائرية بعض القوانين و المراسيم التشريعية من أجل تحقيق ادارة بيئية مستدامة.

الكلمات المفتاحية: النفايات الصلبة البلدية، الجزائر، المبادئ R3، مبدأ الملوث يدفع، ادارة بيئية مستدامة.

1. Introduction

The environmental concern is very important because the interest of a clean environment is among the most important pillars of sustainable development. Therefore, the amount of waste we produce is the result of our unsustainable lifestyle. Wealth and waste are interdependent in our society; the wealthier we get the more waste we produce. Most of waste can be treated by incineration, composting or landfill. However, all these methods cause air, water and soil pollution, which is harmful to human health, plants, and animals. Therefore, developed countries promote waste prevention reduction, reuse, and recycling. In addition to environmental and social benefits, waste management and recycling activities also provide major job opportunities. This research analyzes the situation of municipal solid waste management in Algeria. Moreover, it shows a set of different experiments in managing municipal solid waste whether in developed or in developing countries. Therefore, these experiments can help to get some ideas and suggestions that may support the development of municipal solid waste management to reach the well-being of any society.

2. Background

In reality we all relate to the environment, however, we construct it in certain ways. Therefore, we are all affected by changes to our environment (Meg Keen et. al, 2005). Indeed, a common definition of the environment is "the physical, chemical, and biological factors external to a person" (Paul Stevens, 2010). The need to increase our understanding of how we interact with our environments is a fundamental learning step towards more sustainable environmental management. (Meg Keen et. al, 2005). Over the last decade, environmental issues have become

increasingly more important world-wide (Eberhard Seidel, and Hans J.Thamhain, 2002), and environmental economics emerged during the 1960s (Jeroen C.J.M, and Von den Bergh, 2007).

In 1987, sustainable development became an accepted phrase for the main task of environmental management, and understood to be a balance between economic development, social equity and environmental sustainability. According to the World Commission on Environment and Development “WCED” sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” Starting in the early 1990s, the concept of sustainable development re-emerged (Hawken, 1993), and a new vision of environmental stewardship emerged with the notion of sustainable development (Eberhard seidel and Hans J.Thamhain, 2002). The concept of sustainability is not a single plan, but a framework for dynamic and adaptable decision-making. The basis for sustainable development is the efficient use of resources and an effective infrastructure that supports both environmental quality and economic development. And a major driver toward sustainable development is the increasing realization that clear competitive advantages accrue to companies that can integrate their environmental policies with their general business strategies. Therefore, sustainable development encourages a holistic, multidisciplinary approach to environmental challenges with parallel solutions, and broad cooperation among all stakeholders from action groups to government and industry (Nurik and Thamhain, 1993). It builds on the idea of natural environmental cycles; waste from one organism is used to sustain another one. Hence, countries are competing to reach sustainable development.

Not too long ago, many companies had chosen between operating their businesses either environmentally responsible or economically effective. Therefore, environmental protection is a long-term issue of survival for individuals, companies, and societies. And environmental concern must be the cornerstone to our operations (Eberhard Seidel and Hans J.Thamhain, 2002). Also the establishment of affordable, effective and truly sustainable waste management is the cornerstone of sustainable development (Bogner.J, et. al, 2007). Indeed, the environmental protection is a mission that cannot be assigned to a single department, but requires the involvement of all actors of society (Samir, 2008). According to Partha Dasgupta (2008), trade improves the environment, because it raises incomes, and the richer people are the more willing

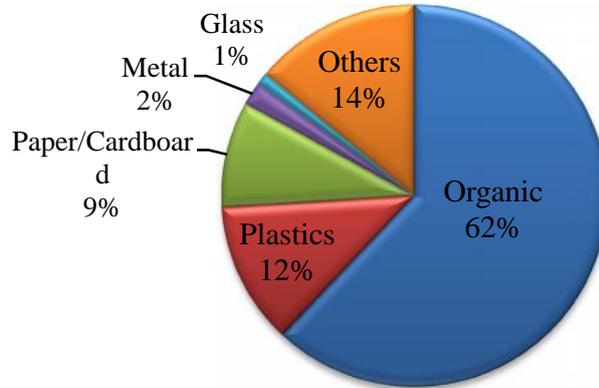
they are to devote resources to cleaning up their living space. However, the richer people produce more waste (NEST, & EMAS, 2007), and municipal solid waste generation is closely linked to population, urbanization and affluence (Martin Medina, 2000, UNEP, 2001, USEPA, 2002, Bhoj Rajkhanal and Bounsouk Souksavath, 2005, Pracriti, 2006, Bogner.J, et. al, 2007, Guilberto Borongan, et. al, 2010 and Dong Qing Zhang, et. al, 2010).

3. Municipal Solid Waste

Municipal solid waste is the general waste collected by municipalities which is generated mainly by households, commercial activities and street-sweeping, as well as construction and demolition debris (Martin Medina, 2000, Linda Tietjen, et. al, 2003, Olar Zerbock and M.S. Candidate, 2003, Pracriti, 2006, USAID, 2009, and Guilberto, et. al, 2010). In general, municipal solid waste is composed of three groups of materials: organic waste (kitchen, garden waste, etc), non-recyclable inorganic waste (coal ash, cinder, dust, etc), and recyclable waste (paper, plastics, glass, metal, etc) (Dong Qing Zhang, et. al, 2010).

The Algerian municipal solid waste contains a high proportion of Organic, plastic, and paper/cardboard. However, glass and metal make very low proportions. And 14% of the municipal solid waste contains other types (Kehila Youcef et. al, 2010). The following figure “1” shows the constituent ratios of municipal solid waste in Algeria for 2009.

Figure 1: Algerian municipal solid waste in 2009



Source: Kehila Youcef et. al, 2010

Moreover, papers and organic waste make up a high proportion of European municipal waste streams with an increasing share of plastic (European communities, 1999). However, municipal waste in many developing countries contains a high percentage of food waste with high moisture contents (Bogner.J, et al, 2007). It also contains varying amounts of industrial wastes from small industries, as well as dead animals, and fecal matter (Martin Medina, 2000). Unfortunately, more of the goods that we buy now come in more packaging which forms a big volume of municipal solid waste (European communities, 1999). Consequently, as production becomes cheaper, the municipal solid waste increases (Olar Zerbock and M.S. Candidate, 2003). The table“1” below shows more details about the sources where municipal solid waste comes from and the different types of MSW.

Table 1: Sources and Types of Municipal Solid Waste

Source	Typical Waste Generators	Types of Solid Waste
Residential	Single and multifamily dwellings	Food waste, paper, cardboard, plastic, textiles, leather, yard waste, wood, glass, metal, ash, special waste (e.g., bulky items, consumer electronics, white goods, batteries, oil, tires) and household hazardous waste
Industrial	Light and heavy manufacturing, fabrication, construction sites, power and chemical plants	Housekeeping waste, packaging, food waste, construction and demolition materials, hazardous waste, ash, special waste
Commercial	Stores, hotels, restaurants, markets, office buildings	Paper, cardboard, plastic, wood, food waste, glass, metal, special waste, hazardous waste
Institutional	Schools, hospitals, prisons, government centers	Same as commercial
Construction and Demolition	New construction sites, road repair, renovation sites, demolition of buildings	Wood, steel, concrete, dirt, etc.
Municipal Services	Street cleaning, landscaping, parks, beaches, other recreational areas, water and wastewater treatment plants	Street sweepings; landscape and tree trimmings; general waste from parks, beaches and other recreational areas; sludge from water and wastewater treatment plants
Process	Heavy and light manufacturing, refineries, chemical plants, power plants, mineral extraction and processing	Industrial process waste, scrap materials, off-specification products, slag, tailings

Source: World Bank, 1999

4. Municipal Solid Waste Management

To manage waste effectively, any organization and household must understand the quantity and type of waste that occurs on site, the reasons why it is generated and find opportunities to prevent or reduce the generation of that waste (SFA, 2007). In 2009, the quantity of municipal solid waste 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 Youcef et al, 2010). The management of municipal solid waste can be divided by several levels according to the World Bank (2005).

4.1 The 3R Methods (Reduce, Reuse, and Recycle)

Starting from last century's mid-eighties, the 3R Principles: Reduce, Reuse, Recycle became increasingly implemented in many Central European countries (CE & PA, 2007). Unfortunately, there is a poor culture with respect to the 3R Principles in Algeria.

4.1.1 Reduce

The first step in waste management is to try and prevent the generation of waste by reducing at source the waste produced. This is the prevention principal "avoidance of waste" (NEST, & EMAS, 2007, N.O. Adedipe et. al, 2005, and Bhoj & Bounsouk, 2005). The responsibility for reducing waste generation generally lies with management, who decides what is brought into the property and, thereby, determine what eventually leaves the property as waste (PA- USAID, 2001). In order to reduce the environmental impacts and the generation of waste in the course of the production and subsequent use of products, the Europe countries encourage the design of products (Dirk Le Roy, et. al, 2012). In order to value food waste, LeanPath, Inc¹, made a food waste tracking systems. It records detailed information about all food waste prior to disposal, in lighting speed (LeanPath Inc, 2008).

4.1.2 Reuse

Where reducing is not possible, the waste generated should be reused. As early as 1991, the local government of Munich (the capital city of the state of Bavaria, Germany) banned the use of disposable paper plates, plastic cups, forks and knives at large-scale public events. They are replaced by reusable items for which consumers pay a deposit that they get back when they bring back the items (NEST, & EMAS, 2007). For example In China, in order to avoid using plastic bags, the Chinese government has created a policy 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, such as in Algeria, 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

¹ LeanPath, Inc is a technology company providing cost control and sustainability solutions to the foodservice industry. LeanPath, Inc partners with leading foodservice organizations at sites in more than 22 U.S.states, with customers including ARAMARK, Sodexo, Compass Group, Guckenheimer and MGM Mirage.

deposit equivalent to the cost of the bottle. This encourages the return of reusable bottles, (Martin Medina, 2000) which is in parallel encouraging the reuse principle.

Recently, repairing furniture, bicycles etc..., is often more expensive than buying new products. In many countries reuse centers have been established. These centers aim to break the short product to waste cycle extending the life of the products through repairing them and selling them at a low price. The reuse centers can also be used as means of creating employment for people with problems in entering the job markets or suffering from long term unemployment. For example in Flanders (Belgium) the reuse centers employed over 2,500 people in 2005 (NEST, & EMAS, 2007). Another example, in Nanchang (Jiangxi province in China) the government provides a big and clean center for second hand products such as refrigerators, cookers, chairs, desks, TVs etc... to encourage the reuse policy. The Sysav Company in Malmo, Sweden has a really impressive purpose-built center the size of a large supermarket where the public and trades-people can buy a huge range of materials collected and sold for reuse by the company (NEST, & EMAS, 2007). However, in Algeria there are only some small shops for second hand products, but unfortunately, there are no reuse centers.

In Japan and other industrial countries, "industry clusters" have been planned, where the waste of one industry is the resource of another (N.O. Adedipe et al, 2005). If the waste cannot be reused on site such as in hotels, the property should investigate the possibility of selling it or donating it to employees, charitable organizations, schools, businesses or other interested parties (PA-USAID, 2001). Again if this cannot be achieved the waste should be recycled.

4.1.3 Recycle

In 2002, 2% of the Algerian municipal solid waste was recycled (METAP, 2003). Afterwards, that percentage has risen to 4-5% in 2009 (Kehila Youcef et. al, 2010). And the recycling capacity is shown in the table "2". Recycling in Algeria depends more on paper than plastics and metals. However, plastics represent high percentage than papers (in figure 1). This shows that there is a percentage of plastic which is not exploited in recycling.

Table 2: recycling capacity

types of waste	quantity (tons/year)
Paper	385,000
plastic	130,000
metals	100,000
glass	50,000
various materials	95,000
total	760,000

Source: Boukelia and Mecibah, 2012

Recycling has a lot of positive aspects, it creates job opportunities and it provides products in less prices. In fact, recycled paper might be up to 25% cheaper than normal white paper. In 2003, Chandaria and Pegant were two major recycling companies in Nairobi. Chandaria has the capacity to recycle 50 tons of waste paper per day, while Pegant is able to process of 25-27 tons per day. The Mukuru Recycling Project, established by UN-HABITAT used to collect five types of waste: paper, metal, glass, textiles for recycling and the profit and utilization benefited many slum dwellers (SBS, 2004). In 2005, the recycling industry in Britain, already worth over \$20 billion a year, and employs 140,000 people (N.O. Adedipe et. al, 2005). Mechanical recycling of plastics resulting from discarded TV sets in Japan is a more attractive option than incineration, which has a larger environmental burden (S.M. AL-Salem and P. Lettieri, 2009). In 2006, the total amount of collected recyclables in Japan reached 3 million tons (Guilberto Borongan, et. al, 2010). In Vientiane city in Lao country, in the schools, student and teachers are operating and managing the recycling banks as an extra-curricular activity. They bring recyclables from their homes once a week to deposit in the school bank. When the bank is full, they contact a private company to come and buy their recyclables. Then, they distribute the income among themselves and the school administration proportionately (Bhoj & Bounsouk, 2005). In china and other countries, there are a number of scavengers who go everywhere to collect bottles and papers from people or waste collection containers and sell it to the recycling centers.

The policy that incorporates waste reduction, reuse, recycling and composting called “zero waste” which means zero disposals and zero warming from waste (Marie Marciano, 2011). Indeed “zero waste” seems to be a difficult but not impossible task. If various options for waste management

can be integrated and applied over long period, waste minimization can be addressed effectively and sustainably (N.O. Adedipe et al, 2005). For example, with a national zero waste program, the US could cut its emissions by an amount equivalent to closing 21% of its coal-fired power plants (Marie Marciano, 2011). Another example is the Australian strategy for zero solid waste management, in December 1996, to achieve, by 2010, a society where no waste is sent to landfill (N.O. Adedipe et al, 2005). Recycling can save from 1.5 to 5 times more energy than is generated by incineration (NEST, & EMAS, 2007).

4.2 Composting

In 2002, 1% of municipal solid waste was composted in Algeria (METAP, 2003). However, this ratio decreased to 0% in 2009 (Kehila Youcef et. al, 2010). Therefore, there is almost non-existent culture of composting in Algeria. Many developed and developing countries practice composting and anaerobic digestion of mixed waste or biodegradable waste fractions such as kitchen or restaurant wastes, garden waste, and sewage sludge. Composting can be sustainable cost in developing countries (Bogner.J, et. al, 2007). The city of Accra in Ghana has a successful creative variation on this theme: a co-composting plant that converts human waste sludge and solid waste to compost which is then sold to recover the plant's operating costs. In Uganda, community-based groups are experimenting with backyard composting, using the compost in a variety of ways, from conventional agriculture to producing fishpond algae as fish feed (USAID, 2009).

4.3 Incineration

Incineration controlled burning of solid, liquid or gaseous combustible wastes to produce gases and residues containing little or no burnable material (Linda Tietjen, et. al, 2003). It reduces the amount of organic waste in municipal waste to about 5% of its original volume and sterilizes the hazardous components, while at the same time generating thermal energy that can be recovered as heat or electric power or combinations of these (Matt Crowe, et. al, 2002). There is 30% of burned waste in open air in public dumps or municipal uncontrolled ones in Algeria (Boukelia and Mecibah, 2012).

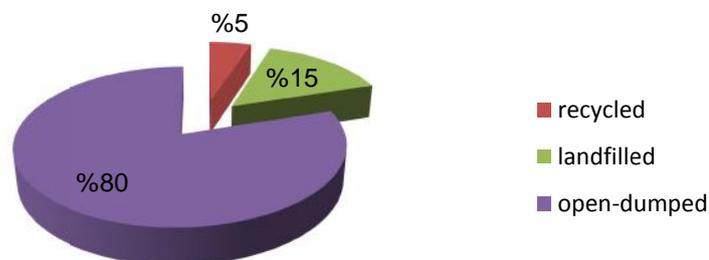
Recently, incineration has been widely applied in many developed countries, especially those with limited space for landfill such as Japan and many European countries. In 2003, about 17% of municipal solid waste was incinerated with recovery in the EU-25. In 2006, the EU-15 indicates that 20-25% of the total municipal solid waste is incinerated at over 400 plants with an average capacity of about 500t/d (Bogner.J, et. al, 2007).

4.4 Landfill

One way to dispose of municipal solid waste is to place it in properly designed, constructed, and managed landfills, where it is safely contained (USEPA, 2002). However, landfill creates environmental damages. Therefore, the EU countries increase the landfill costs due to increasingly stringent regulations, taxes, and declining capacity in order to reduce Landfill of municipal solid waste (Bogner.J, et. al, 2007 and Mette Skovgaard, et. al, 2008).

Recently, in several countries considerable reductions in the landfill of waste have taken place (Mette Skovgaard, et al, 2008). However, in Algeria 15% of the municipal solid waste was send to landfill in 2009. There are more than 3,000 uncontrolled dumps throughout the country, occupying an area of more than 150,000 hectares (Kehila Youcef et. al, 2010).

figure 2: final destination of municipal solid waste



Source: Kehila Youcef et. al, 2010.

The collection and treatment of household waste is usually a municipal responsibility, they also collect waste from small and medium sized companies, because this waste is comparable to household waste (NEST, & EMAS, 2007). In France, the municipalities are required to collect waste and keep the towns clean. Some groups of municipalities are specialized in waste

collection and financed by taxation; other, larger, groups are in charge of waste treatment and receive fees paid by the member authorities (Brahim Djemaci, 2009).

It is much easier to keep wastes separate from the beginning than to separate them after they are mixed. Moreover, one immediate measure collection service structure is to provide community waste bins conveniently placed for the people to deposit waste. As first step, this will ensure that people do not throw their garbage on the roads and hence do not create open dumpsites (UNEP, 2001). Besides, there is a good example of solid waste management educational program for 15 minutes a week in Lao television, which helps to provide people's awareness for environmental protection (Bhoj & Bounsouk, 2005). As well, innovation offsets can reduce pollution because it improves productivity with which resources are used, thus is often coincident with reducing pollution (Michael and Caas, 1995).

5. Legislative Framework and Policy for Municipal Solid Waste in Algeria

In the 1950s, there were no federal, state or local governments responsible for environmental management in all over the world. However, environmental legislation was slowly and reluctantly introduced into a number of countries and jurisdictions (Meg Keen, et. al, 2005). Therefore, environmental policies are issued to regulate the behavior of humans and economic organizations (Jeroen C.J.M, and Von den Bergh, 2007). According to Michael and Caas (1995), firms can actually benefit from properly crafted environmental regulations that are more stringent than those faced by their competitors in other countries. As a role in France, waste management policy is based on three types of instrument, to wit legislative or regulatory instruments, economic instruments (incentive, taxation, etc.) and other instruments (awareness raising, training, etc.) (Brahim Djemaci, 2009). In addition, the displacement of legislation, policy and government regulation by business when it comes to environmental protection is a controversial development (Linda C. Forbes and John M.Jermier, 2010). Indeed, in recent years, local and regional governments are responsible for developing and implementing municipal waste management 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. 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, such as the ISO 14000 family, ISO 14001, 14004, and most recently LCA Standard 14040⁸, 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 (EMS) (Eberhard Seidel, and Hans J.Thamhain, 2002). In 1972, “polluter pays” principal has appeared by the Organization for Economic Cooperation and Development (OECD), which requires that the polluter must deduct from the public authorities expenses procedures designed to preserve the environment in acceptable condition (kamel Razik, 2007). Framing higher taxes in the key terms, “polluter pays”, has certainly helped legitimate environmental taxes and charges (Jon Hovi, et. al, 2011).

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 municipal solid waste management (kamel Razik, 2007). 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 3: tax on the collection of household waste

amounts (Algerian Dinar)	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

Municipal Solid Waste Management National Program (PROGDEM) which is launched in 2002 has already made possible development of many projects (municipalities’ master schemes, landfills, sorting centers, etc.). Algerian government has created some laws and executive decrees to manage municipal solid waste appropriately. And the table “4” bellow shows more information.

Table 4: Algerian Legislative laws for Municipal Solid Waste Management

laws and executive decrees	the related field
law No.01-19	The management, control and disposal of waste.
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 decree04-199	The modalities for the establishment, organization, operation and financing of the public system of treatment and recovery of packaging waste.

Source: Kehila Youcef et. al, 2010

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). Therefore, Algerian legislation should focus more on reduce, reuse, and recycle to minimize the amount of waste.

6. Conclusion & recommendation

We may influence the environment positively or negatively because we are all relate to the environment. However, we can also provide the protection of the environment at the same time. Through the real examples of municipal solid waste management in developed and developing countries, we can reach some concluding recommendations such as:

The most important factor that can help to protect the environment, as well as encouraging reduce, reuse and recycle is the education. It is an essential element of waste management, particularly waste reduction. Through formal education starting with kindergarten to primary schools, middle schools, high schools, and universities. And organize waste prevention campaigns in schools. Or also through television programs same as in Lao television which has a solid waste management educational program for 15 minutes a week.

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.

For encouraging reuse principle, Algerian government should consider establishing reuse centers. The unpleasant odor and unattractive appearance of piles of uncollected solid waste along streets can discourage tourism. Therefore, 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 to keep wastes separate from the beginning to be easier than to separate them after they are mixed through providing separate bins for collection of different wastes to facilitate waste recycling and recovery.

As it is mentioned before, the recycling of plastic is very low, and large quantities of plastic are not recycled. Consequently, the Algerian government should create some incentives to encourage the recycling of the plastic.

Avoid purchasing heavily packaged products and minimize packaging to minimize the amount of waste or reuse packaging where possible.

Use more reusable products such as the reusable bags which made of cloth or jute, and reuse the plastic bags as possible.

Develop policies at the national or local level addressing municipal solid waste management through 3R principles. As well as encourage the recycling industry.

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