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Inert Waste Management in Developing Countries: from Regulation to Practice - The Case of Constantine (Algeria)

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Abstract

Despite the efforts of the local authorities, inert waste management remains inadequate, as evidenced by the appearance of illegal dumps and their abundance and anarchy within the districts. As a result, nuisances affecting both citizens' living environments and the environment have emerged and multiplied. This article serves two functions. On the one hand, it seeks to comprehend the organization of inert waste management at construction and demolition sites. On the other hand, it attempts to demonstrate the impact of inadequacies in the legal arsenal relating to inert waste on their efficient management through the commune of Constantine. To accomplish this, we used a comparative approach to compare the modes of inert waste management in Algeria and developed countries. The findings indicate that legislation governing inert waste management is insufficiently developed. The study suggests that the current way of managing waste be looked at and that a good legal system be put in place to protect natural resources and get rid of illegal dumps. It also suggests that everyone work together to manage inert waste.

Key words: Constantine, management, inert waste, regulation

INTRODUCTION

Human activities always generate waste, and each era has its own treatment and disposal methods. Landfill appeared to be the most practical solution at first. The emphasis has shifted over time from uncontrolled dumps to controlled dumps, with the latter receiving waste of all types in bulk and thus becoming a threat to the environment itself. The need to reduce pollution, save energy, and manage natural resources has made waste treatment a critical issue for the planet's survival (Balet, 2008, p. 4). To make sure that waste is managed in an integrated way, it is important to know how much waste is made and how it moves from where it is made to where it is collected, treated, and stored (ONS, 2006, p. 71).Algeria, like the rest of the world, is producing more waste. The country's socioeconomic and demographic changes over the last three decades have been accompanied by significant changes in the quantity and quality of solid waste generated. Household waste increased from 10.3 million tons in 2012 to 13 million tons in 2018.(GIZ,2014)

At the regulatory level, an important legal arsenal has been put in place to allow Algeria to comply with the international commitments to which it has subscribed in order to ensure environmental management with a view to sustainable development (Giz, 2014, p.21). On December 12, 2001, a framework law, law n°01-19 on waste management, control, and disposal, was promulgated. This new law established modalities for the management, control, and treatment of three types of waste (household and similar, special waste, including hazardous and inert waste) in its 72 articles. As a result, it established the national program of integrated municipal solid waste management (PROGDEM) and the communal scheme of household and similar waste management (SCGDMA). The goal of PROGDEM is to keep public hygiene and agglomeration cleanliness high, improve the living environment of citizens and protect their health, get rid of trash in a way that doesn't harm the environment, recycle trash, and create green jobs (Rahmani, 2011, p. 13).

Our research focuses on inert waste from construction, demolition, rubble, road construction, and other sources. These wastes are frequently dumped in urban areas and in the natural environment, which harms the landscape and citizens' living conditions. Measures have been taken to address this situation, including the establishment of controlled dumps and landfill sites suitable for this type of waste, but these are insufficient. The expansion of the population is accompanied

by an increase in the demand for housing and local amenities. To meet this demand, the number of construction and public works sites is rapidly increasing, resulting in an increase in the amount of inert waste generated (AND, 2020, p. 96).It is always difficult to make precise estimates of waste volumes. However, previous building site waste management experiments have revealed an average volume of 10 m3 per dwelling. This volume is equivalent to approximately 3 tons of waste per dwelling, or 50 kg per m2 of living space (CNIDEP). Our goal in this article is twofold.On the one hand, we want to learn about the organization of inert waste management at construction and demolition sites. On the other hand, we will use the case of the commune of Constantine to show how the inadequacies of the legal tools for managing inert waste have an effect.

METHODS AND MATERIALS

Extensive fieldwork is required to achieve the goals outlined in this article. The method used is based on an analytical approach that includes knowledge of the policy, current regulations, and all actors involved in the management of construction and demolition waste.The study was completed by an observational survey and direct interviews with local officials, namely the Directorate of the Environment and the Public Establishment of Industrial and Commercial Character (EPIC) of the management of the technical landfills of the wilaya of Constantine. Also examined is the data provided by organizations such as the National Agency of Waste Management on the evolution and treatment of waste (AND). This work is finished with a study of how inert waste is handled in Algeria, specifically in Constantine, the capital of eastern Algeria, and in European countries. This is done to understand the gaps and lack of regulations that have led to situations that are bad for both people and the environment.

WASTE MANAGEMENT POLICY IN ALGERIA

Waste reduction and recovery are critical aspects of the emergence of a green and circular economy, which is one of the seven strategic axes of the National Environment Strategy for Sustainable Development and its accompanying PNAEDD 2020–2024. This waste management policy has also been formalized with the passage of the waste management, control, and disposal law, as well as the establishment of the National Plan for the Management of Special Wastes (PNAGDES) and the National Program for the Integrated Management of Municipal Solid Waste (PROGDEM). The PROGDEM implementation aims to eliminate illegal dump practices and organize the collection, transport, and elimination of household waste in conditions that ensure environmental protection and the preservation of environmental hygiene, particularly through the realization, installation, and equipment of waste treatment facilities in all wilayas. This program has enabled the development of 1257 SDGDM waste management master plans for the country's 1541 communes as well as the implementation of 500 SDGDM in major cities, allowing for the improvement of the collection system and public safety.In addition, to date, the PROGDEM has enabled the realization of over 111 technical burial centers (CET) and 120 controlled dumps for the elimination of household and similar waste, 38 CET for inert waste, 10 sorting centers realized in large city CET, and 05 waste collection centers.These successes have also led to the closing and/or cleaning up of 1700 of the 3000 illegal dumps that were there. Special attention was paid to cleaning up illegal dumpsites in big cities like Oued Samar in Algiers (NUA, 2021).

LEGAL CLASSIFICATION OF WASTE IN ALGERIA

The terminology for various types of waste and their treatment methods varies by country. Waste is defined in Algerian law as any residue of a production, transformation, or use process as well as any substance or product and any movable property whose owner or holder discards, intends to discard, or is required to discard or eliminate it (article 3). Numerous texts have been produced in France over several decades in order to optimize the management and reduction of negative effects on human health and the environment. Waste, according to the law of July 15, 1975, is any residue of a production, transformation, or use process, any substance, material, or product, or, more broadly, any movable property abandoned or intended for abandonment by its holder. The law of July 13, 1992, completes the 1975 law, most notably by prohibiting the landfilling of non-ultimate waste beginning on July 1, 2002 (Turlan, 2008, p. 5).The classification of solid waste is as follows, according to article 5 of the law N°01-19 of 12/12/2001 on waste management, control, and elimination:

-hazardous waste, including special waste

-domestic and similar waste

-waste that is inert.

The same law defines "inert waste" as "waste from quarrying, mining, demolition, construction, or renovation work that does not change physically, chemically, or biologically when dumped and is not contaminated with dangerous substances or other elements likely to harm health and/or the environment" (art. 3).Inert waste is defined as: "waste that does not decompose, does not burn, does not produce any physical or chemical reaction.Itis not biodegradable, and does not deteriorate other materials with which it comes into contact in a way that is likely to cause environmental pollution or harm to human health" (the French Environmental Code, article L.541-30-1 and R.541-65 to 75).

INERT WASTE IN ALGERIA BETWEEN PRODUCTION AND MANAGEMENT

Definition and Consistency

According to executive decree n° 06-104, section 17 of the list of inert wastes removes the list of inert wastes belonging to the construction and demolition activities that we are interested in (Table n° 1). Other inert wastes from other industries are added to these wastes. The following is the structure of a code number: -The first number represents the category that tracks the sector of activity or process from which the waste is derived; -The second number represents the section that tracks the origin or nature of the waste in the category; -The third digit represents the heading that tracks the waste designation.

Table 1. Inert waste list

code	Designation of the waste	Sectors of activity
1.3.1	Waste gravel and stone debris	Mining and Industry
1.3.2	Sand and clay waste	
1.3.3	Waste from stone cutting and sawing	Handicrafts
1.4.1	Mud and other drilling wastes containing fresh water	Industry and Crafts
2.4.1	Soil from beet washing and cleaning	Handicrafts
10.12.1	Preparation waste before cooking	Industry
10.12.2	Decommissioned mussels	
10.12.2	Waste ceramic products, bricks, tiles and construction materials after firing	
10.3.1	Concrete waste and sludge	
17.1.1	Concrete	Buildings and public works
17.1.2	Bricks	
17.1.3	Tiles and ceramics	
17.1.4	Concrete, brick, tile and ceramic mixtures	
17.7.1	Gypsum-based building materials	Industry
17.8.1	Mixed construction and demolition waste	Buildings and public works
19.4.1	Vitrified waste	Industry
19.12.5	Minerals (e.g. sand, pebbles)	Mining and Industry
20.2.2	Earth and stone	/

Source: Synthesized by authors

We also want to emphasize that there is a legal framework in Algeria for inert waste (construction and demolition). In other words, the management of inert waste is part of a clear set of rules, which are summarized in table n°2.

Table 2. principal texts on inert waste

Type of text	number	Year of enactment	Title
law	01-19	2001	on the management, control and disposal of waste
Executive Decree	04-410	2004	the general rules for the design and operation of waste treatment facilities and the conditions for the acceptance of waste at such facilities
Executive Decree	06-104	2006	nomenclature of wastes, including hazardous special wastes

Source: Synthesized by authors

However, there are few laws and decrees that govern the management of inert waste; the legal system has been simplified to include only the law 01-19 and the executive decree 06-104. The main focus of the regulatory framework is on waste from homes and similar places, as well as special and dangerous waste.

Inert Waste Production in Algeria

Algeria had approximately 11 million tons of inert waste in 2016, primarily from the building and public works sectors, which could increase to 27 million tons by 2035 (Ministry of Environment and Renewable Energy, 2017). Building and public works activities have increased over the last few decades, resulting in a growing influx of waste from construction sites. Today, inert waste accounts for 48% of total waste production (AND, 2017), a significant figure in a context where its growth is not accompanied by the expansion of collection and recycling facilities, and even less by the expansion of recovery facilities. This type of waste is produced by activities such as construction and development, civil engineering infrastructure, renovation, rehabilitation, and demolition.Construction sites generate a wide range of waste of varying sizes.

Inert Waste Managers

Several actors are involved in the project's realization: the owner, the project manager, the construction's technical control service, the companies and subcontractors, and so on. Waste management affects them all, either directly or indirectly. Because each actor bears a portion of the responsibility, the management task becomes more difficult. To clarify the role of each actor, it is best to divide them into two categories.These actors may, in fact, be waste generators or waste holders (figure 1).

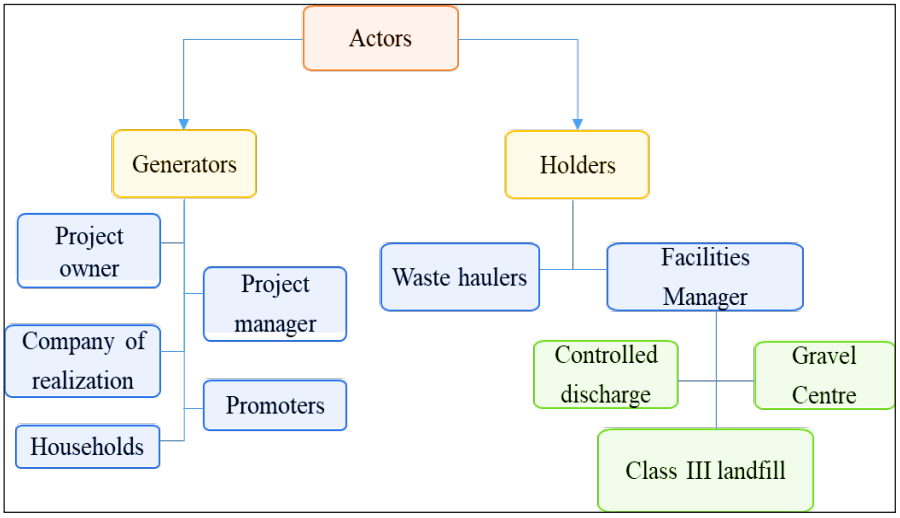

Figure 1. Inert waste actors (authors)

The Actors Generating the Waste

A waste generator, as defined by Law 01-19, is any natural or legal person whose activity generates waste. The construction and public works sector in Algeria is both the largest consumer of natural resources and the largest producer of inert waste. Indeed, the majority of waste generated comes from the construction of various types of housing, the construction of equipment, the demolition of shantytowns, cottages, and constructions in violation, and the modifications inside the housing after dwelling. There are also projects for the construction of new infrastructure (roads, highways, and railways), as well as projects for urban improvement (within the districts). Based on the above projects, we can name the four groups that contribute to the creation of inert waste:

- **The project owner**: According to Article 2 of Executive Decree No. 14-320 of November 20, 2014 on project ownership and delegated project ownership, the State, as a legal person of public law, initiating a project or program for its study or implementation, clearly defined and whose objectives, means, and expected result are dedicated, is considered the project owner. These projects or programs, whether new or within the scope of an ongoing program, are included in the framework of sectoral programs, whether centralized or decentralized. In reality, the project owner makes no mention of the environmental impact of construction waste.

- **The project manager**: According to the interministerial decree (of July 4, 2001 amending the interministerial decree of May 15, 1988 on the terms and conditions for the exercise and remuneration of project management in the building industry), project management is a global function covering the design, study, assistance, monitoring, and control of the construction of buildings, regardless of their nature and purpose, excluding industrial buildings. It is carried out under the project manager's own responsibility within the framework of contractual obligations binding him to the project owner. The project manager is a natural or legal person who meets the requirements of professional qualifications, technical skills, and financial resources to carry out building project management missions on behalf of the project owner, by committing to the latter on the basis of a target cost, deadlines, and quality standards. Most design firms do not take into account technical rules about using recycled building materials and reducing waste when planning projects.
- **The construction firm**: Construction companies generate a significant amount of inert waste (concrete, bricks, tiles, ceramics, floor coverings, glass insulation materials, and so on). The numerous building construction and rehabilitation sites, as well as the numerous building demolition sites, generate significant amounts of debris of various types (AND, 2020). Most of the time, inert waste is taken straight to the right landfills or rubble areas.
- **Households:** When people make changes to their homes' interiors or build their own houses, they contribute to the production of inert waste. Some people dump their garbage near their homes or in the neighborhoods around them.

Waste Holders

A waste holder is defined in Law 01-19 as any natural or legal person who holds waste. They can be waste carriers or facility managers (controlled landfill, rubble center, or class 3 landfill). In other countries, inert waste landfills are similar to class 3 technical landfills. They are implemented based on a study and managed by the EPIC of management of the CET of the relevant wilaya. The rubble areas, on the other hand, are simply areas where inert waste is dumped.The majority of inert waste ends up in the 30 rubble areas on the national territory (figure 2), but this is not always the case; there is a waste flow that ends up in the wild dumps (AND, 2020). The SNGID thinks that by 2035, the amount of inert waste going into rubble areas will go down, and the number of class 3 landfills (CET class III) will go up.

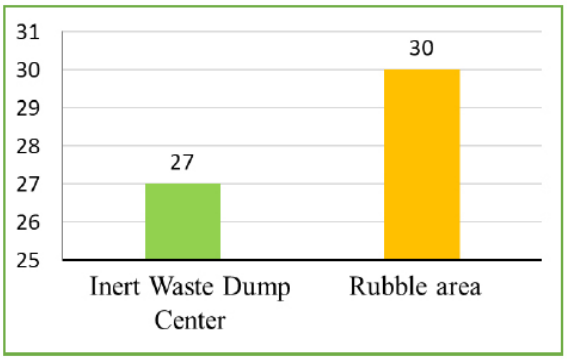

Figure 2. Number of installations at the national level (Source: AND, 2020)

LEGAL DEFICIENCIES' IMPACT ON INERT WASTE MANAGEMENT INCONSTANTINE

City Development and Waste Generation

Regional junction, Constantine is located in the heart of Algeria's North-East. The metropolis of Constantine is situated between the Tigris and the high plains.It is a road crossroads because it is crossed by the country's main axes in the east, namely the North-South (Skikda-Batna-Biskra) and West-East (Sétif-Annaba and Tébessa) axes. In fact, it connects the major cities of eastern Algeria and runs from north to south (figure 3). Because it is in a good place geographically, Constantine is an important place for people and goods to move through (PDAU Constantine, 2020).

Urban expansion has been and continues to be accomplished through the addition of housing programs on the one hand, and road infrastructure on the other. Indeed, Constantine wilaya has benefited from the national construction program for the development of integrated urban centers. These urban centers are required to meet the population's needs for housing, facilities, and services (Annuairestatistique de la wilaya de Constantine, 2020). It has witnessed the implementation of various housing programs under various formulas (LPL, LSP, LPA, LPP, AADL, CNEP-IMMO, and so on), as well as the construction of several local facilities in the educational, health, cultural, and religious sectors, among

others. This significant increase in the number of construction sites in the building and public works sectors for the implementation of all of these programs multiplied the quantities of construction and demolition wastes in general and inert wastes in particular, whose impact is harmful.

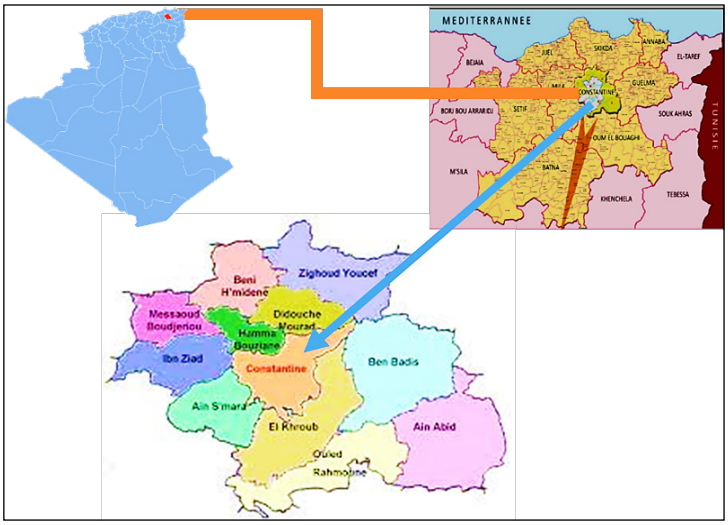

Figure 3. Geographic Situation of Constantine

Some Impacts of Inert Wastein Constantine

Algeria lags behind in the management of inert waste, which is frequently dumped in unauthorized dumps, causing an environmental impact, particularly because construction and demolition waste are not sorted and inert waste is mixed with hazardous waste. If trash isn't picked up properly in Constantine, it ends up in nature, where it can be seen and smelled.

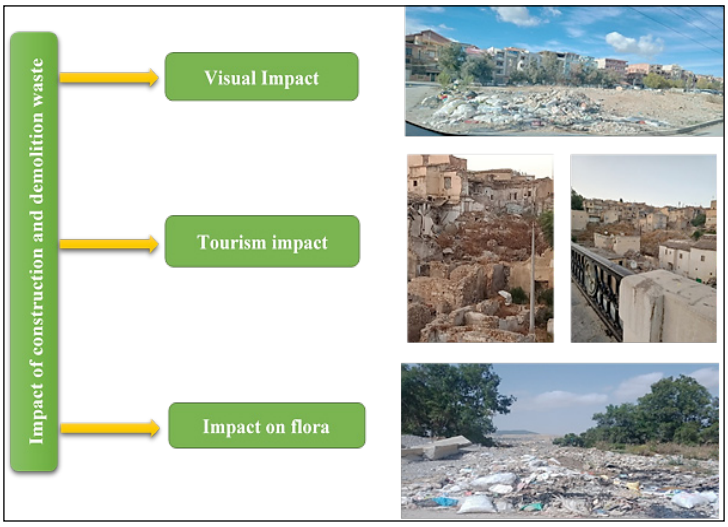

Figure 4. Expansion of waste in different parts of the city of Constantine (Source: authors)

Deficiencies in the management of inert waste in Constantine

In general, generators are responsible for the collection, sorting, transportation, and disposal of inert waste. The municipality initiates any action and measures aimed at the implementation, development, and management of landfill sites designated to receive inert waste within the framework of its planning and development plan and in accordance with the approved management scheme. In France, however, Article 46 of the Law n° 2009-967 of August 3rd, 2009 on the Implementation of the Grenelle de l'environnement provides: "A regulatory, economic, and organizational framework to improve the management of certain waste flows, particularly through the development of selective collections and appropriate channels... waste from the building and public works sector" (Record, 2011). In terms of planning, "the obligation to set up waste management plans for building and public works sites and to do a diagnosis before demolition sites" (Record, 2011).

In Terms of Collection and Transportation

Article 37 of Law 01-19 states that the collection, sorting, transportation, and disposal of inert waste is the responsibility of the generators. Depositing, rejecting, and abandoning inert waste is prohibited on any site not designated for this purpose, particularly on public roads. In France, an interministerial circular issued on February 15, 2000, stated the need to plan the management of construction and public works waste at the departmental level in order to comply with national regulations and the goals of the waste law of July 13, 1992 (Direction Départemental de l'Equipement du Puy de Dôme, 2007). The circular's objectives are as follows:

- Combat illegal dumping and enforce waste regulations;
- Establish a treatment network capable of providing local service to building and public works professionals, both for recycling and disposal facilities for recoverable materials and landfill facilities for final waste.
- Involve construction companies in the concept of waste reduction at the source.
- Reduce landfill use and promote waste recovery and recycling;
- The previous one's goal is to allow the use of recycled materials on construction sites, with two goals in mind: to create outlets for the recycling industry and to conserve nonrenewable material resources; and to involve public contracting authorities in the elimination of waste generated by the execution of their orders.

Construction waste in Constantine is collected and transported by building and public works companies to controlled landfills. Similarly, waste generated by individuals during the rehabilitation or renovation of their homes is dumped in designated dumps or in wild dumps, on public roads or within districts. The EPICs only collect this waste during clean-up operations (figure 5).

Figure 5. Dumping of inert waste by individuals and companies in a controlled landfill(Source: authors)

In terms of the absence of sorting

Some developed countries, such as Austria, require that "all fractions of construction, deconstruction, and demolition waste be sorted for recovery" (Ordinance on the sorting of construction and demolition waste BGBI Nr 259/1991). Waste must be sorted on-site or in construction and demolition waste treatment plants "(Record, 2011). Despite the fact that waste sorting provides economic and environmental benefits, there are currently no regulations requiring it. Construction and demolition waste is a mix of inert waste (concrete, earth, etc.) and non-hazardous waste (textiles, wood, plaster, etc.) as well as hazardous waste (paint, plastic, etc.). (Figure 6).

Figure 6. Lack of separation of construction and demolition waste (Source: the authors)

In Terms of Storage and Disposal

Non-recyclable inert waste can only be deposited on developed sites, according to article 39 of law 01-19. while article 38 states that the municipality must initiate all actions and measures aimed at the establishment, development, and management of landfill sites designated to receive inert waste, within the framework of its planning and development plan and in accordance with the approved management scheme. The waste dumped in landfills is not only inert waste, but it is also mixed with hazardous and non-hazardous waste, causing an environmental impact. In Constantine's case, the city has only one controlled landfill for inert waste, which is located in the new city of Ali Mendjeli. It mostly gets green waste, demolition waste, and construction and demolition waste, as well as cuttings and gravel. Figure 7 shows only the waste that was dumped in the Ali Mendjeli controlled landfill. Waste from the building and public works industries in Constantine cannot be evaluated because it is often dumped in illegal landfills.

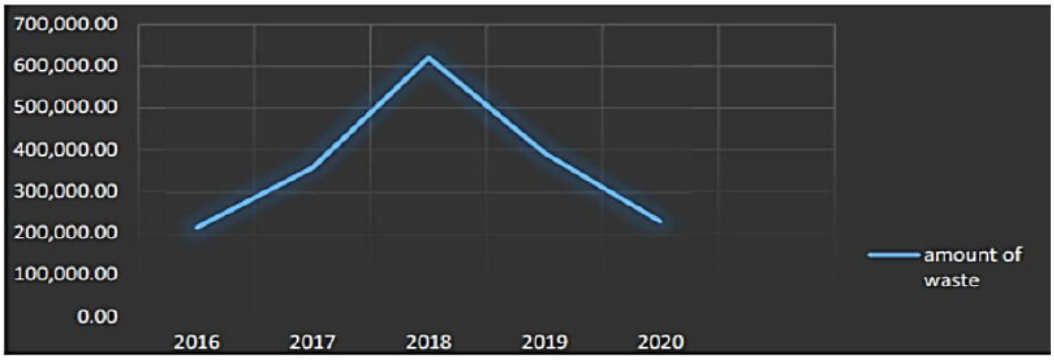

Figure 7. Evolution of the quantity of inert waste from the Ali Mendjelicontrolled landfill (Source: authors based on CET Constantine 2021)

In Terms of Monetary Value

Inert waste is easily recycled into alternative materials to quarry aggregates for use in road construction (ADEME, 2017). Despite the importance of the deposit, which represents a very strong economic potential for the municipality, the inert waste recovery sector is unfortunately absent. This is true in all Algerian cities, as the country as a whole lags far behind in the management of this type of waste. Recycling of inert waste is already developed in Europe. Although it necessitates the pre-selection of recyclable materials on-site, this process consists of the production of aggregates through the crushing and screening of building demolition materials, engineering structures, and pavements (asphalt crusts, gravel, and so on).

CONCLUSION

Algeria has traditionally relied on landfills to eliminate construction and demolition wastes in general and inert wastes in particular. The field report revealed deficiencies in the mode of management of inert waste in comparison to developed countries, specifically France. As a result, it is necessary to transition to a management model that is more environmentally conscious while also being economically and socially profitable. To preserve natural resources, it is necessary to sort out at the building site level and to create channels of sorting and recycling of construction and demolition wastes at the level of controlled dumps or technical burying centers class III, with the goal of developing these wastes and lowering the cost of their elimination. It is important to get everyone involved in the management of inert waste by making it clear what each person or group is responsible for through a clear legal and regulatory framework and a clear schedule of conditions.

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