



PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA
MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC
RESEARCH
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SCIENCES



END OF STUDY THESIS

In view of obtaining the Master's degree LMD

Domain : Nature and Life Sciences

Division : Ecological sciences

Option : Environment and Vegetal Ecology

THEME

**Waste Management in Algeria, Role
of the National Waste Agency
(AND)**

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Defended publicly on June 27th, 2023

In front of the jury composed of:

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College year : 2022/2023

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الملخص

ان كمية النفايات المتزايدة تعتبر مشكلة بيئية عالمية و وطنية , كما أن إدارة النفايات مصدر قلق كبير في الجزائر بسبب تأثيرها البيئي والاقتصادي السلبي إذا تم القيام بها بشكل خاطئ. من بين الخطوات الفعالة لإدارة النفايات هي تأسيس الوكالة الوطنية للنفايات (و.و.ن)، التي تم إنشاؤها بموجب المرسوم التنفيذي رقم 02-175 المؤرخ 20 مايو 2002. تحت إشراف وزارة البيئة و الطاقات المتجددة . تتكفل الوكالة بتقديم خدمات عمومية للاعلام عن والترويج لتقنيات الفرز والجمع والنقل والمعالجة والاستعادة والتخلص من النفايات. و كذلك تشكل قاعدة وثائقية حول إدارة النفايات وتضمن نشرها للسلطات المحلية وقطاع الأعمال. كما تقوم بتنفيذ برامج واستراتيجيات الوزارة الوصية في مجال إغلاق وإعادة تأهيل مكبات النفايات.

الكلمات المفتاحية : إدارة , النفايات , و.و.ن , الجزائر .

Abstract

The increasing amount of waste is a global and national environmental problem . Waste management is a major challenge in Algeria due to its negative ecological and economic impact if done wrong. Standing today, the largest and most effective organization at implementing effective means of waste management is the AND (National Waste Agency), created by Executive Decree No. 02-175 of May 20, 2002. Placed under the supervision of the Ministry of the Environment and Renewable Energies, it is responsible, within the framework of a mission, to provide a public service to inform and popularize the techniques of sorting, collection, transport, treatment, recovery, and disposal of waste. It capitalizes on and constitutes a documentary base on waste management and ensures its dissemination to local authorities and the business sector. It also implements the programs and strategies of the aforementioned Ministry in the field of closing and rehabilitating illegal waste dumps.

Key words : management , Waste , AND , Algeria .

Résumé

La quantité croissante de déchets est un problème environnemental mondial et national , la gestion des déchets est un défi majeur en Algérie en raison de son impact écologique et économique négatif si elle est mal faite. Aujourd'hui, l'organisme le plus important et le plus efficace pour mettre en œuvre des moyens efficaces de gestion des déchets est l'AND (Agence Nationale des Déchets) , créée par décret exécutif n° 02-175 du 20 mai 2002. Placée sous la tutelle du Ministère de l'Environnement et des Energies Renouvelables. Energies, elle est chargée, dans le cadre d'une mission, d'assurer un service public d'information et de vulgarisation sur les techniques de tri, de collecte, de transport, de traitement, de valorisation et d'élimination des déchets. Il capitalise et constitue une base documentaire sur la gestion des déchets et assure sa diffusion auprès des collectivités locales et des entreprises. Il met également en œuvre les programmes et stratégies dudit Ministère en matière de fermeture et de réhabilitation des décharges sauvage.

Mots clé : Gestion , Déchets , AND , Algérie .

DEDICATIONS

I dedicate this work to my dear mother, my
family, and my friends

ACKNOWLEDGMENTS

First and foremost I thank **ALLAH** for with His will this work was made possible

I would like to thank professor ABDESSELAM Amira for facilitating the trip/internship during the training in the National waste Agency , for guiding me and being understanding.

All my gratitude to the jury members for accepting the examination of this work: Professor CHAIBI Rachid as present of the jury and Doctor KHEDIM Rabah as examiner.

My sincere acknowledgments go to all the service managers that shared their expertise with us during the internship especially Miss Sarah HADID, the responsible of the internship, for her engagement and efforts.

I cannot forget to thank all my teachers during my study years in Biology department.

ABBREVIATIONS/TERMS LIST

1. ABBREVIATIONS

ACL : chief town agglomeration (agglomération chef-lieu)
AND : national waste agency (agence national des déchets)
AS : secondary agglomeration (agglomération secondaire)
BTP : Building and public works (Batiment et travaux publics)
CET : technical landfilling center
DA : similar waste (Déchet assimilé)
DAS : healthcare waste (déchet d'activité de soins)
DM : Household waste (Déchet ménagé)
DMA : Household and similar waste (Déchet ménagé et assimilé)
EPIC : Public establishment of an industrial and commercial nature
GPS : Global Positioning System
HDPE : High Density Polyethylene is a polyethylene thermoplastic made from petroleum
IPCC : The Intergovernmental Panel on Climate Change
MARPOL :The International Convention for the Prevention of Pollution from Ships
PCB : are toxic, persistent manmade chemicals that were widely used as an oil additive in electrical equipment and as a plasticizer in building materials
PEDB : Low-density polyethylene is a thermoplastic made from the monomer ethylene
PET : Polyethylene terephthalate . a type of clear , strong , lightweight and 100% recyclable plastic
PP : Polypropylene . a tough , rigid , and crystalline thermoplastic .
PS : Polystyrene is a synthetic polymer made from monomers of the aromatic hydrocarbon styrene
PVC : Polyvinyl chloride is the world's third-most widely produced synthetic polymer of plastic
ROI : Return on investment is a metric used to understand the profitability of an investment
SNID : National Waste Information System (Système National d'Information sur les Déchets)
SNID : national waste information system (système national d'information sur les déchets)
UNFCCC :The United Nations Framework Convention on Climate Change
ZE : sparse area (zone éparse)

2. TERMS

Black Spot: is an accumulation of waste (around a week or 10 days) that hasn't yet been picked up by municipality trucks .
Circular Economy : Is a model of production and consumption, which involves sharing, leasing, reusing, repairing , refurbishing and recycling existing materials and products as long as possible.
Controlled dump : is a miniscule **CET** that has less infrastructure and equipment .
Exploitation authorization : is an administrative authorization necessary for the exploitation of a land, a mine, or a trade .
Green Climate Fund GCF :The Green Climate Fund is a fund established 2010 within the framework of the United Nations Convention on Climate Change as an operating entity of the Financial Mechanism to assist developing countries in adaptation and mitigation practices to counter climate change.
Illegal dump : is an accumulation of waste (years) in a certain place , generating leachate

and biogas , posing a threat to the environment , requiring intervention and large financial cost to remove .

SAIDAL : Sidal Group is an Algerian pharmaceutical company created in 1982. Sidal Group is the largest pharmaceutical company in Algeria and one of the largest in Africa.

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INTRODUCTION

1. INTRODUCTION

Waste is all the residue of a production process, transformation or consumption, whose owner or holder is obliged to undo or eliminate it. (Augris et al., 2001).

Waste management concerns the collection, transport, treatment, reuse or disposal of waste produced by human activity (Augris et al., 2001).

Today the cities of developing countries in general, and those of Africa in particular, are among the cities where the issue of environmental management is relevant. The collection of household waste is one of the greatest difficulties encountered by urban authorities. These difficulties result in an accumulation of household waste, the creation of numerous illegal dumps and the stagnation of wastewater and rainwater in many neighborhoods. (Nikituahanga, 2010).

In Algeria, the **DMA** production is estimated at around 0,68 (kg/day/inhabitant) (National Waste Agency, 2022).

DMA and other types of waste are dumped in more than 3000 illegal dumps occupying more than 150,000 hectares. This waste is a source of various pollution but also a source of energy and raw materials. (AND, 2020).

The quantity of household and similar waste in Algeria, estimated at 13 million tones in 2018, should exceed 20 million tones in 2035, according to a study carried out by the Ministry of the Environment. (ALGERIE PRESSE SERVICE, 2021).

Boudibi and Bourwiba service managers at the **AND** mention that old or poorly managed landfills can have strong impacts on the environment, such as the scattering of light waste (paper, bags plastics, etc.) by the wind or water-soluble waste, the attraction of vermin and the release of pollutants into the air and into water and soil (mainly biogas and leachate).

Algeria faces significant challenges in waste management due to its growing population, rapid urbanization, and industrial development. The state of waste and waste management in Algeria is a pressing issue that requires immediate attention.

One of the primary concerns is the increasing amount of municipal solid waste generated by both urban and rural areas. As the population expands and consumerism rises, the volume of waste has surged, straining the existing waste management infrastructure. Insufficient collection systems and inadequate disposal sites have resulted in the accumulation of waste in public spaces, contributing to environmental pollution and health risks.

Furthermore, the improper disposal and lack of recycling facilities exacerbate the problem. While there are efforts to promote recycling, they remain limited in scale and effectiveness. The absence of widespread awareness and education on waste segregation and recycling practices further hinders progress in waste management.

Indeed, the increase in waste and its diversity raises awareness of the environmental and health risks associated with their simple dumping in the open air, constituting today a threat to our environment (Fao, 1976).

The issue of waste remains crucial in Algeria, which is why the government has put in place regulatory mechanisms for several years, institutional and financial resources to solve the problem of waste experienced by the majority of Algerian cities.

Thus a major bulwark against waste pollution in Algeria was created, the National waste agency , also known as the **AND** (Agence Nationale des Déchets) was created by Executive Decree No. 02 – 175 of May 20, 2002. Placed under the supervision of the Ministry of the Environment and Renewable Energies, it is responsible, within the framework of a mission of subjecting a public service to inform and popularize the techniques of sorting, collection, transport, treatment, recovery and disposal of waste. It capitalizes on and constitutes a documentary base on waste management and ensures its dissemination to local authorities and the business sector. The agency also implements the programs and strategies of the aforementioned Ministry in the field of closing and rehabilitating waste dumps which presence harms its direct and indirect environment .

Sarah Hadid a service manager at the **AND** states that the goal of this agency is the study and management of waste , it consists of 6 directorates , a general directorate which audits the other directorates , directorate of administration and finance , directorate of communication and marketing , directorate of engineering , directorate of green economy development , directorate of integrated waste management .

It is in this context that We have therefore decided to study and analyze the methods of waste management executed by **AND** .

From there , the research theme that We will address in the context of preparation of My end-of-study dissertation essentially focuses on “**Waste Management in Algeria : Role of The National Waste Agency**”

In this perspective, the main problem that my study seeks to solve is : **what are the missions and responsibilities of the AND regarding waste management in Algeria ?**

MATERIALS AND METHODS

2. Materials and methods

This was purely a practical work , We embarked on an internship regarding the management of waste in Algeria , that was in the **AND** Corporate office located in Mohamed Belkacemi, Belouizdad rue des fusillés Algiers , within a period of 5 days from 7 to 11 may 2023 , where we acquired valuable knowledge and insight on the missions and responsibilities of the **AND** (with backup in the form of audio recordings) , we gained understanding of 3 directorates , Directorate of Integrated Waste Management , Directorate of green Economy Development , and directorate of engineering , every one of these directorates has several departments that we learned about through service managers that we've encountered . in addition to a field trip to the rehabilitated waste dump of Oued Smar where the largest landfill in Algeria was closed.

This dissertation seeks to highlight the importance of the AND National Waste Agency's work and its contribution to advancing waste management practices in Algeria.

2.1. Location:

The main internship took place in the **AND** Corporate office located Algeria Mohamed Belkacemi, Belouizdad, rue des fusillés-Algiers (*Fig.1*).



Figure 1 national waste agency headquarters (Djeddou, 2021)

The field trip took place in rehabilitated waste dump of Oued Smar currently a public

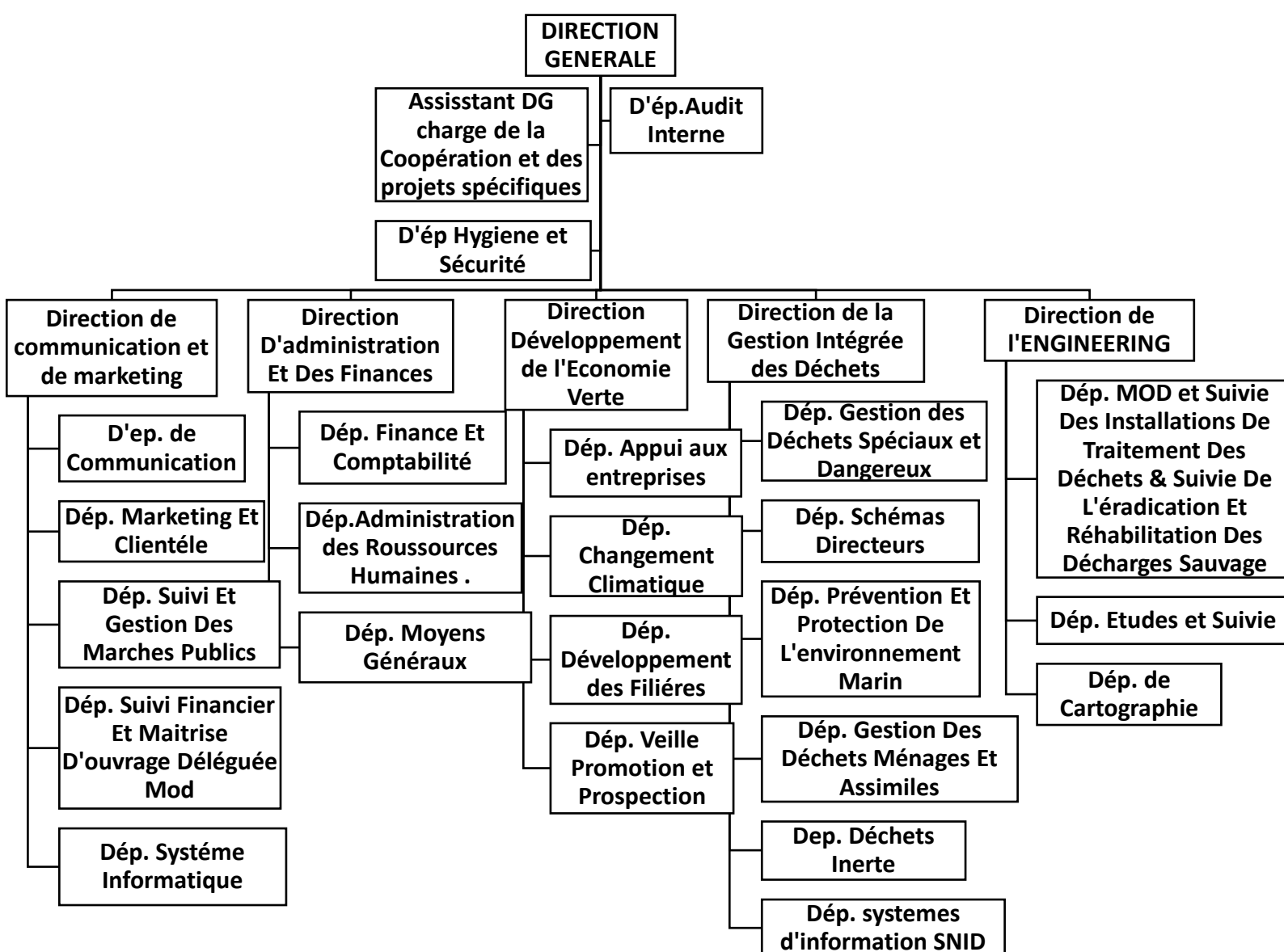
park, it is located in the middle of the eastern suburbs of Algiers, in the municipality called Oued Smar (Fig. 2).



Figure 2 Oued Smar dump after rehabilitation (ZEHRAOUI, 2022)

2.2. Organogram of the agency:

This is the original (in French) Organogram provided by the agency, no changes have been made in order to be faithful to the source material



RESULTS AND DISCUSSION

3. Results and discussion

3.1. Principal missions of AND departments and directions:

3.1.1. Directorate of Integrated Waste Management (Direction de la Gestion Intégrée des Déchets):

A. Department of management plans: (Dép. Schéma Directeur)

Srawi Abdmalek service manager of this department stated all of the following:

This department's mission is to create waste management plans, according to Decree 07.205, the different municipalities must work on waste management according to a plan specified by this department.

The department works based on 3 phases:

a- Diagnostic phase:

-The department checks who is responsible for waste management in a certain municipality. Is it the municipality itself, an EPIC that belongs to the wilaya, or a private EPIC.

-Human and material means that are available

-Pre-collect, packaging, collect, treatment (illegal dumps, CET, or recycling), cost accounting (the expenses, management cost)

b-Phase 2: proposal of solutions:

There are urgent actions that have priority, the most profitable choices (who takes charge of the management municipality or a private EPIC) solutions for the packaging of waste, pre-collect, collection, treatment, costs etc....

c-Phase 3: Financial estimate of investments for the implementations of these plans.

B. Department of household and similar waste management :(Dép. Gestion Des Déchets Ménages Et Assimilés)

Issaad Walid service manager of this department stated all of the following:

Household and similar waste is waste that is generated as a result of the ordinary day-to-day use of a domestic premise, can be generated from households or local business activities (stores, restaurants etc...) also known as domestic waste include food waste, paper, glass, metals, plastics, textiles, etc.

-In 2020 there was approximately 12.6 million tons of DMA generated.

-60% of DMA goes to CET or Controlled dumps, 10% valorized, the remaining 30% goes to Illegal dumps.

-Decree 06.104 defined all the nomenclature of waste.

This department has 3 main missions:

- a- Creation and management of databases: management of DMA (reports or data sheets by wilaya) the data sheet is a summary of waste management in a wilaya , valorization operators (these operators can sign in the agency websites , the agency can help publicize them , events etc...) .
- b- Studies about: quantification of waste, characterization of DMA, valorization of sectors
- c- Popular science: treating data extracting indicators and making these indicators available for people (publications, websites etc...)

Quantification of DMA National campaign:

The Ministry of the Environment has mandated the National Waste Agency AND to launch, within the framework of the National Environment and Coastal Fund, a study to quantify household and similar waste DMA on the entire national territory during the 2019-2021 period. the expected goal is to better assess the deposit generated at local and national level, but also to update performance indicators, in particular, the estimate of the quantity of waste generated per day and per inhabitant (kg/day/inhabitant), commonly called “Ratio”. (National Waste Agency, 2022)

C. Department of inert waste: (Dep. Déchets Inerte)

Namir Laila service manager of this department stated all of the following:

Inert waste is generated by the exploitation of quarries, mines, demolition works, construction, renovation, these wastes do not undergo any modification neither chemical nor physical during their discharge, inert waste generators are mostly **BTP** companies.

This waste is divided into 3 categories:

- Inert waste: concrete, bricks...
- Non-inert non-hazardous waste: wood, metals, plastic, etc.
- Hazardous waste: oils, batteries, asbestos(amiante)...

The disposal of this type of waste:

- Class 3 CET.
- Treatment, recovery and reuse (recycling).
- Rubble area (storage area for this type of waste) can be reused or mixed with other materials

In 2016 the estimated waste of **BTP** services was around 11 million tons this number can reach 27 million tons by 2035, if recycling and valorizing strategies are applied, this number can be reduced to 25.7 mill tons.

D. Department of prevention and protection of the marine environment: (Dép. Prévention Et Protection De L'environnement Marin)

Bakir Marouan service manager of this department stated all of the following:

It has 2 objectives:

a-Prevention:

Which is every project, study, activity, with these two goals:

1-Stopping the generation of certain waste all together, except for the type of waste that is inevitable, through awareness campaigns.

2-Reducing or negating the negative effects of waste or reusing it (dealing with every type of waste separately) exp sorting (is a major part in **circular economy**), recycling etc.

b-Protection of the marine environment:

Cleaning and maintaining the cleanliness of: beaches, industrial ports, fishing ports, etc. (which is not the main mission of this department it's done through periodical campaigns in cooperation with the local population)

We can find different types of waste: **DMA**, used oils, fuels leaking from ships etc.

The protection is done through several steps of which:

a-Collecting data about the specific marine environment be it a port or beach etc.: the amount of waste, if this port has systems of recycling waste or dealing with it etc.

b-Selective collect of waste: (placing sorting or recycling sites in ports if possible)

There is national waters and international waters, the latter is subject to the rules set by **MARPOL**.

E. Department of special and hazardous waste :(Dép. Gestion des Déchets Spéciaux et Dangereux)

Gourari Boutheina service manager of this department stated all of the following :
This department missions include :

-Carrying out studies (exp : quantification of **DAS**)

-Actualization of the national plan for the management of special and hazardous waste (first implemented on 2003 then 2011 and now AND is actualizing it in 2023).

-Elaboration on the management of special and hazardous waste for the authorities responsible of waste management

-Information base (frequently updated).

-Data collection.

Special and hazardous waste:

Special and hazardous waste are all waste generated from industrial, agricultural, healthcare sectors and other sectors.

-There are 14 criteria that define a special or hazardous waste of them: explosive, oxidizer, inflammable, radiation, toxic, cancerous.

Examples of special or hazardous waste :

Used motor oils , electric and electronic equipment waste , healthcare activity waste , used tires , filters , **PCB** waste .

-The collect , transport , and treatment is appropriate and not like the rest of the other waste

Elimination differs :

Either through **CET** class 1 , or is recycled like used tires and batteries for exp , or waste that can't be recycled like the **DAS** .

DAS or healthcare waste : there are different color bags for each type of its waste :

-Yellow : infectious risk waste .

-Green : anatomical waste .

-Red : toxic waste .

-White : radioactive waste .

This waste we eliminate through 2 means :

a-Banalization (shredding and disinfecting) : yellow bag waste , or similar waste .

b-Incinerator : destroys all types of waste .

3.1.2 Directorate of green Economy Development (Direction Développement de l'Economie Verte)

A. Department of enterprise support : (Dép.Appui aux entreprises)

Madwi Soumaia service manager of this department stated all of the following :

The department services are mostly not free , these services are geared toward Enterprises and small businesses , enhancing waste management methods , providing financial estimations , providing valuable data . the main services can be represented in these three phases:

a-Diagnostic phase :

The department determines the quantity and composition of waste produced by an enterprise

b-Analysis phase :

The department examines data acquired from the first phase to conclude a set of results (anomalies , the possibility of improvements in waste management) .

c-Improvements/prevention phase :

The department ensures the improvement of waste management quality in an enterprise , and minimizes the quantity of waste and its harmful effects .

Enterprises need an **Exploitation authorization** , in order to gain it certain studies must be conducted , this department can provide these studies which are :

Environmental audit : steps of conducting an environmental audit :

- General presentation of the establishment , which is a study about the surrounding environment (climate , land etc...) .
- Workshop diagram , which is a description of the internal structure of a company (the placement of machines etc... in a confined space relative to each other)
- Diagnostics on the installation of the classified establishment .
- Quantity and quality assessment (of the produced waste).
- The outputs , which include the product it self plus waste (harmful emissions , sewage etc..) there is a certain toxicity/hazardous limit the waste can't exceed according to the regulations.
- Measure for the reduction of generated nuisance .

Danger study :

Is the study of dangers that pose a threat on the safety of employs or the facility in a certain enterprise .

Environmental impact study :

Is the study of the negative impact on the environment (chemicals infiltrating into groundwater , harmful emissions etc..) .

Types of enterprises :

According to the Executive decree n°07-144 there are classified enterprises which need the aforementioned studies for their inception , and there are non classified ones that don't require them .

There are 4 types of enterprises :

- Type 1 and 2 have a bigger impact on the environment thus require a more in depths study and need an authorization from the wilaya or the ministry .
- Type 3 have less impact on the environment and require a impact notice which is a less in depths study , the authorization can be gained from the municipality .
- Type 4 don't need any studies , the authorization can be gained from the municipality .

The department missions/services :

a. "La bourse des déchets industriels" is a digital platform set up by the **AND** in 2015 (bourse.and.dz) , that makes it possible to link supply and demand (be it citizens or enterprises) for waste likely to be recovered (reuse, material recycling or energy recovery) , moreover this website has data sheets about waste and waste management , and advertising space for companies that want to present their offered services within this domain .

b. Entrepreneurship support service that accompanies the development of entrepreneurs in Algeria within the "Green" sectors , and according to a study done by the **AND** the 4 "Green"

sectors with the highest employment potential are :

- Renewable energy sector .
- Forests sector .
- Agriculture sector .
- Waste sector .

This service provides for entrepreneurs and project owners :

1-Information :

Through **SNID** national waste information system (système national d'information sur les déchets) which is an effective decision-making support tool for all stakeholders involved in waste management, it allows the transition from a raw database to a dashboard made up of several indicators relating to waste management in the form of statistics, graphs, and maps .

2-Technical support :

Carrying out technical and economic feasibility studies , whether or not a project owner's idea is feasible technically and economically , is there a market demand for said idea , and is it profitable in the long run (**ROI**) .

3-Valorization of sectors :

This is done by organizing and connecting the different actors within a certain sector and giving them defined and clear responsibilities .

many sectors are unorganized in this domain , for example in the plastic waste sector there is a constant dispute between recyclers and recuperators due to the latter exporting the waste rather than selling it locally .

This department conducts a study about sectors that valorize special and hazardous waste , where it aids project owners with valuable information/data , for example asbestos(amiante) isn't a profitable waste to valorize/recycle because of its low quantities in Algeria (due to the prohibition of its use) .

c. Support for the financial organization :

The municipality is responsible for the collect and treatment of household and similar waste, and this process is costly (4000dinars/ton) , in Algeria there is 11.5 million tons of DMA generated annually this equates to approximately 46 billion dinars , for this reason the Algerian legislation put a tax on the collection of household and similar waste since 1993 , it applies to households , commercial and professional activities , camping activities , industrial activities , on the basis that they pay an annual fee for this service . the regulations regarding this tax are changed/updated almost every year but unfortunately its application is

very weak or non existing , the amount of this tax differs depending on the location of the wilaya/municipality (north, south, etc.) .

A study done by **AND** and the interior ministry between 2019/2021 showed that the income of this tax is just 0.8% equal to 0.6 billion dinar while the cost of management exceeds 139 billion dinar .

B. Department of climate change : (Dép.Changement climatique)

Kebab Kenza service manager of this department stated all of the following :

This department main missions are :

a. Greenhouse gas inventory :

According to the **UNFCCC** convention, every sector must quantify its greenhouse gas emissions , this is done through the **IPCC** Inventory Software that implements **IPCC** Guidelines (2006) for National Greenhouse Gas Inventories .

In Algeria two inventories were published and a 3rd one is under way.

b. Mitigation of greenhouse gases :

Mitigation is done through valorization of greenhouse emissions by turning them into energy using cogeneration.

c. Accreditation :

This department is working to be the first in Algeria to get accredited by the **Green Climate Fund ‘GCF’** , in order to further develop this domain of protecting the environment and waste recycling .

C. Department of sector development : (Dép. Développement des Filières)

Harzalah Sidahmed service manager of this department stated all of the following:
Definition of a sector: It's the combination of actors who are active in this domain , actors are for example :

- Collectors : formal (who operate under the jurisdiction of the law) or nonformal .
- Recuperators : intermediary between the collectors and recyclers , who trade in waste , sell it , most of them in Algeria export it to other countries which negatively effected the recyclers .
- The recyclers : who valorize different types of waste .

A sector is developed because it has an added value , for example the **PET** plastic sector is developed due to its profitability (can be recycled and sold) , on the other hand the sector of special and special hazardous waste is not developed for the fact that their treatment cost is high and there's no profitability , another example is **PP** plastic with a high treatment cost and a low profitability (because the collect and sorting processes are unorganized and

unclear in Algeria) .

The role of this agency is the development of valorization sectors (through certain actions and activities) , for example :

The sector of expired medical waste : This is a special and hazardous type of waste , this department in cooperation with **SAIDAL** developed a pilot project To urge citizens to take this waste to the pharmacies where **SAIDAL** takes care of getting rid of it (legally every waste producer is responsible for it) .

Sector of PET valorization : This department helped create the first cluster of enterprises regarding **PET** recycling and valorization in Algeria .

Eco-Jem:

The public system for the recovery and valorization/treatment of packaging waste "Eco-Jem" was created by Executive Decree No. 04-199 of July 19 , 2004 which sets the terms of creation, organization, operation and financing. of this system. Its implementation and management is entrusted to the **AND** . which did not have the necessary tools for the launch in 2004 , but in 2023 they developed these tools to manage and implement this system . all establishments that produce packaging waste pay financial dues to this system , and that is used as finance for the activities of collect , sorting , management , valorization of packaging waste .

this department also does academic conferences about compost and composting , also provides technical accompaniment in this, for institutions , CET etc...

D. Department of promotion and prospection monitoring : (Dép. Veille Promotion et Prospection)

Boutheldja Aziz service manager of this department stated all of the following :
It has two missions :

a. Technology monitoring :

The goal is to stay updated with new technologies in the world of waste management this department set up a technology monitoring system that notes and keeps up to date with all innovations around the globe , every two or three months there is a new innovation in the world of waste management .

this department provides for innovators in this domain :

-The technology monitoring bulletin , it was created in 2019 and can be downloaded via the **AND** official website , which has all innovations/news in the waste management domain around the planet .

-Guidance through data , expertise , exposure etc...

-An example of an innovation is a plastic bag that dissolves in sea water and can be digested by sea creatures .

b. Documentary monitoring :

That is the digital documentation center (wastedoccenter.dz) , the first in Algeria this website has a plethora of reports , thesis , studies , statistics , manuals , documents etc... regarding waste management .

E. Muhyiddin fella service manager of citizen mobilization : stated all of the following :

Her team focuses on civil associations/society , it offers technical support for local communities , with an integrated watch and alert system that includes a mobile app , called NDIF :

It was launched by The National Waste Agency on July 14, 2019 that made it available to citizens in order to send their grievances in terms of waste management . It is a bilingual application (Arabic / French), downloadable on Play store which allows citizens to report illegal dumps, collection defects, black spots and the lack of dumpsters on the National territory. Thus, the citizen will only have to take a photo and geo-locate himself automatically, which makes it possible to have a reliable complaint which is transmitted instantaneously to the local authorities.

This team's missions :

- Including civil societies in all their projects, field trips, awareness campaigns etc...
- Providing a meeting space for people with ideas, local communities and associations.
- Spreading awareness.
- Targeting the local communities .
- “Naki hoomtek mana” is a project done by this team in 2022 with the local community of Bab El Oued Algiers with the goal of cleaning that region .

3.1.3. Directorate of engineering :

A. Department of MOD and monitoring of waste treatment installations and monitoring of eradication and rehabilitation of illegal dumps : (Dép. MOD et Suivie Des Installations De Traitement Des Déchets & Suivie De L'éradication Et Réhabilitation Des Décharges Sauvage)

Boudibi , I., Bourwiba , b., and Fairuz, A. service managers of this department stated all of the following :

A.1/Eradication and rehabilitation of illegal dumps :

Definition of an illegal dump : An unlicensed , unqualified and technically unequipped place for waste collection and treatment , all types of waste can be found there ,special and hazardous, household and similar waste, inert waste .

The two main hazards of illegal dumps are :

Leachate : Any contaminated liquid that is generated from water percolating through a solid waste disposal site , accumulating contaminants , and moving into subsurface areas .

Biogas : A renewable fuel that's produced when organic matter is broken down by microorganisms in the absence of oxygen , highly inflammable .

Consequences of illegal dumps :

- The visual impact.
- The impact on surface water and groundwater.
- The effluents being leachate and biogas.
- Sliding of waste which leads to a larger spread of said waste.
- The impact on human beings and their health , animals and plants.(smell (amonia,H₂S) , diseases , pollution of the land and crops).
- Geotechnical hazards, since the terrain of illegal dumps can't support the construction of a CET until its decontaminated and checked for stable soil.

An example: we have 2 zones zone a and b zone a is already contaminated we transport the waste from zone a to b and treat it there then once zone a is fully cleared we can utilize it for future projects as well.

-Fire and explosion hazards. of biogas especially CH₄ which has no smell, color and is explosive in closed areas.

Elimination of illegal dumps: Depends on the illegal dump and the danger level of its waste, its usually done through:

- Burying the waste under multiple layers, a layer of inert earth (typically clay) is put directly above the waste , then a layer of geomembrane , then a second layer of clay , and finally layer of topsoil .
- Building an infrastructure, to either valorize or eliminate biogas (use it for energy , burn it, or release it into the air if it's not that dangerous) and eliminate/treat the leachate .

Examples of illegal dumps that the AND dealt with :

The eradication of the illegal dump of Oued Smar , which was the biggest dump in Algeria and one of the biggest in Africa , 45 hectares of polluted land was recovered and turned into a public park , with the construction of facilities for the treatment of biogas and leachate .

The illegal dump of karma wilayat Oran with an area of 85 hectares its located right next to sebkha which a nature reserve , the leachate is bordering the sebkha , and has a zone with

constant fires due to CH₄ (methane), the eradication of this landfill is finished and 85 hectares of land was successfully recovered .

The illegal dump of Bordj Bou Arreridj located in the midst of a forest , 25 hectares was recovered , work there is being finalized all what's left is planting the vegetation .

The illegal dump of Draa Smara wilaya of media located in a valley , the work there is over and hectares was recovered .

A.2/Monitoring of waste treatment installations :

1/Definition of a CET : A classified technical installation according to the decree number 7.144 , it's a center that specializes in burying waste through technical landfilling , this landfilling is done via scientific methods and modern technologies , to preserve the citizens health and protect the environment .

This department offers technical support for CETs to improve the management of said technical installations .

2/Classes of CETs :

Class 1: For special and hazardous waste (exp: health care waste and what's derived from petrol) this type of CET doesn't exist currently in Algeria , two are under construction one in Tbessa and one in Sidi Belabass.

Class 2: For household and similar waste (exp: paper , cartons , cans , plastic , organic waste etc...) .

Class 3: For inert waste (exp: bricks , construction waste etc...) .

3/Structure of a CET :

-The exterior wall .

-An informative sign that has general info about this site (the name , phone number ,type of waste treated etc...) .

-A monitoring outpost , all trucks coming to the CET must pass by this outpost where a worker will visually verify the type of waste being transported and the documents of the driver and the waste .

-Weighbridge , the payload must be weighed before the truck can go through (for data and statistics) .

-Sorting center , not all CETs are equipped with this , with the purpose of valorizing recyclable materials and extending the trench's lifespan .

-Composting center for organic waste , not all CETs are equipped with this .

-The trench , which has at the bottom different layers that prevent leachate from exiting it , first is a layer of clay then geomembrane then geotextile to protect the geomembrane from

sharp objects and the like , then a draining layer (gravel) , and at the surface it is sealed with the same layers mirroring the first ones .

- The administration offices .
- The storage (where some equipment is kept).
- Leachate storage basin .
- Leachate and biogas treatment station .

Table 1 Variation of protection horizons according to permeability and thicknesses of passive waterproofing (AND/CTB, 2016)

Indication des épaisseurs des couches d'étanchiété minérale en fonction de la perméabilité									
Epaisseurs en matières (Hydraulic gradient=0)									
Horizon preserve (années)	Permeabilité m/s								
	1E-03	1E-04	1E-05	1E-06	1E-07	1E-08	1E-09	1E-10	1E-11
1	31.536,00	3.153,60	315,36	31,54	3,15	0,32	0,032	0,0032	0,0003
5	157.680,00	15.768,00	1.576,80	157,68	15,77	1,58	0,158	0,0158	0,0016
10	315.360,00	31.536,00	3.153,60	315,36	31,54	3,15	0,315	0,0315	0,0032
20	630.720,00	63.072,00	6.307,20	630,72	63,07	6,31	0,631	0,0631	0,0063
30	946.080,00	94.608,00	9.460,80	946,08	94,61	9,46	0,946	0,0946	0,0095
Type de sols	Roches		Graviers	Limons			Argiles		

We can notice that Clay soils have lowest permeability among the different soils , which results in low infiltration rates this is the main reason why it was chosen as the preferred material for the isolation of waste (Table.2) .

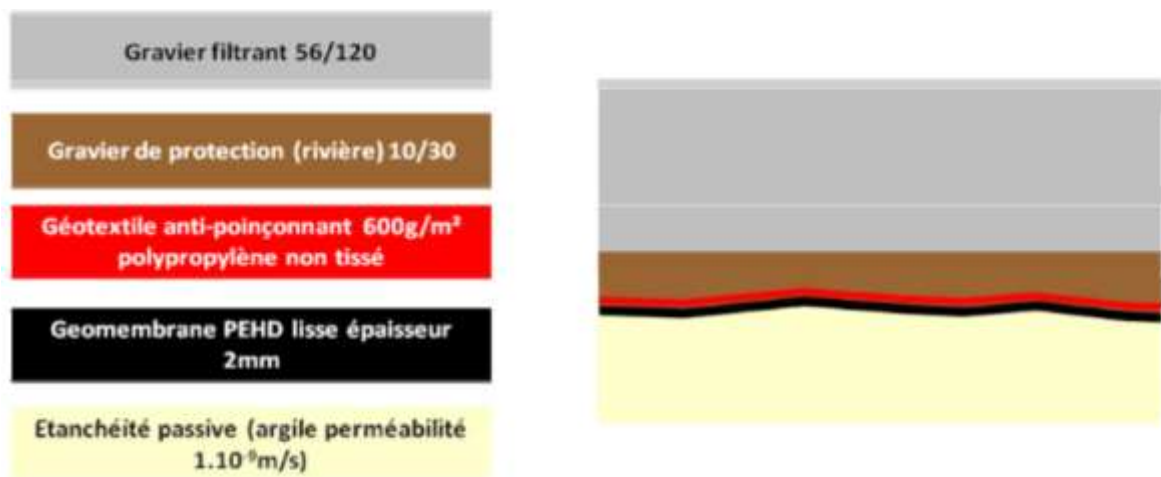


Figure 3 Waterproofing/drainage complex at the bottom of the trench (AND/CTB, 2016)

At the bottom of the trench we can find gravel in direct contact with waste then

geotextile then clay in that order (Fig.3)

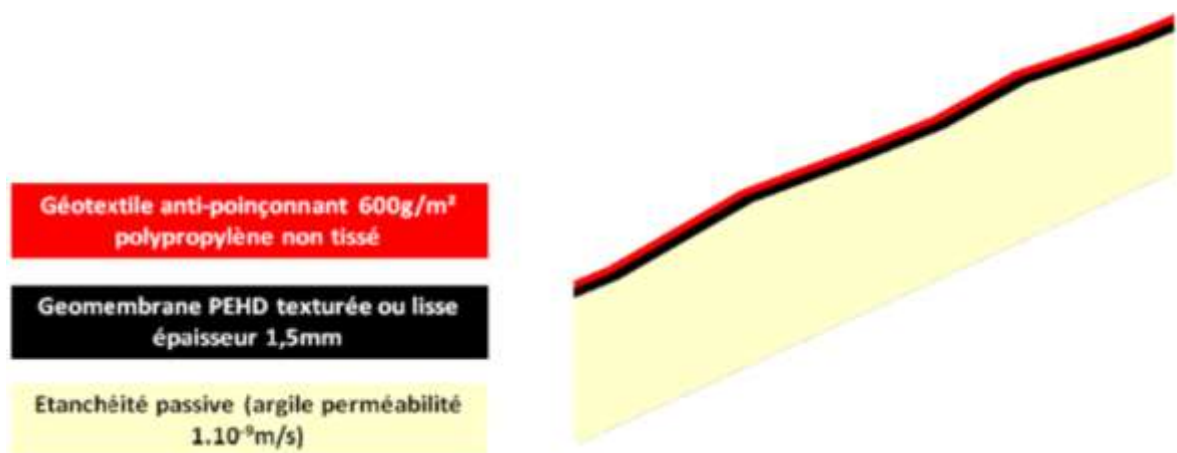


Figure 4 Waterproofing/drainage complex on the trench's sides (AND/CTB, 2016)

At the sides of the trench we can find geotextile in direct contact with waste then geomembrane then clay in this order (Fig 4)

4/The mode of exploitation and management of waste in technical installations :

The support that this department gives to its clients include :

- Technical audit .
- Completion of trench exploitation plans .
- Measuring the degree of biogas emission .
- The water balance , to measure the amount of rain that falls in one of the trenches , and also the dimensions of said trenches .
- Evaluation of trench exploitation duration .
- Field escort in trench exploitation .

The standards before a trench can be exploited :

- Checking for anomalies (drainage system , geomembrane and geotextile being intact) .
- They use a device that's called FID (flame ionization detector) and **GPS** to detect CH₄ (component of biogas).

Exploitation :

- Before trucks can unload the waste into the trench or compactors arrive , a platform must be built at the entrance of the trench , to protect the geomembrane from tearing (this process is repeated with every layer of waste).
- Trucks unload the waste into the trench then compactors compact it , compacting extends the lifespan of the trench and produces leachate .
- Waste is unloaded in layers and every layer is covered with a permeable cover (against the smell and waste flying off due to wind, can be sand or inert waste , it mustn't exceed

15 cm ,depending on the quantity of waste entering the station every day, a cover is added every 24 h to 72 h) , first layer is around 1.5 to 2 m so to protect the geomembrane from the compactors , second and every other layer can be 1 to 1.5 m depending on the exploitation study/plan that include the volume and density of each layer and the coverage .

Closing of the trench :

A layer of geomembrane then a layer of clay then a draining layer (gravel) then finally a layer of topsoil (vegetation soil) where different vegetation can be planted.

A treatment station for biogas and leachate would be set in place.

The area would then become a public park or a garden etc...

B. Department of study and Monitoring : (Dép. Etudes et Suivie)

Massoud Salah , Oulkhari Mouloud service managers of this department stated the following :

The main mission of this department is gathering and providing data and regulations regarding CET's :

The goal of a **CET** is the eradication of the hazards of waste.

The trenches (where the waste is deposited) of a **CET** must be environment friendly, must be impermeable (the leachate must not leak outside the trench , nor the biogas) the bottom of said trench has 2 different impermeable layers (with addition to geotextile and gravel which are secondary layers) , the first one is passive which is clay , and the other one is active which is the geomembrane , a trench must be 10 meters deep .

The **AND** has eradicated around 2600 illegal dumps since its inception.

C. Department of cartography: (Dép. de Cartographie)

Aarar Mariem service manager of this department stated the following:

This department uses GIS (geographic information systems) such as ArcGIS (currently being used by this department), QGIS (free to use for students), Mapinfo (older software).

GPS is essential for cartography all coordinates come through a **GPS**, a member of the department for example would take multiple XY coordinates of a certain location (perimeter of an illegal dump, the tracks of municipality garbage trucks, black spots etc...) that would then be translated to a multitude of dots on a map on ArcGIS software, or be used to calculate the area, the volumes etc...

Phases of cartography :

- Collecting data (on the field).
- Analysis (making maps, plans etc...).
- Exploitation (results/data management).

-Sharing the data.

There are multiple layers for a map on ArcGIS:

Lines, dots, polygons, raster images, there are also tables to be filled with information about the location (for exp a **CET**) names, constructions, infrastructures, surrounding environment, biogas levels, all the different data regarding the studied location that is brought through a data sheet by coworkers on the field.

This department works with all directions by turning their data into visual plans and maps can also be in 3D (3DSMAX).

For example with the department of management plans:

Phase 1: the maps produced summarizes all data brought by the **AND** field coworkers of the current state of the studied region (the previously mentioned, garbage trucks rotations etc...).

Phase 2: the **AND** makes a new plan for the waste management of that region and the cartography department makes maps based on that plan.

Phase 3: the execution of that plan with the aid of the maps provided by this department

3.2. Waste production in Algeria according to time, types of wastes and regions:

These statistical figures summarize the results acquired through the **Quantification of DMA National campaign** accomplished during the span of 3 years from 2019 to 2021.

(*Fig.5*) represents the wilayas and cities sampled in addition to the distances traveled during the Quantification of DMA National campaign. Ten wilayas where sampled from different zones (North Algeria, high plateau and Sahara) to make results as representative as possible.

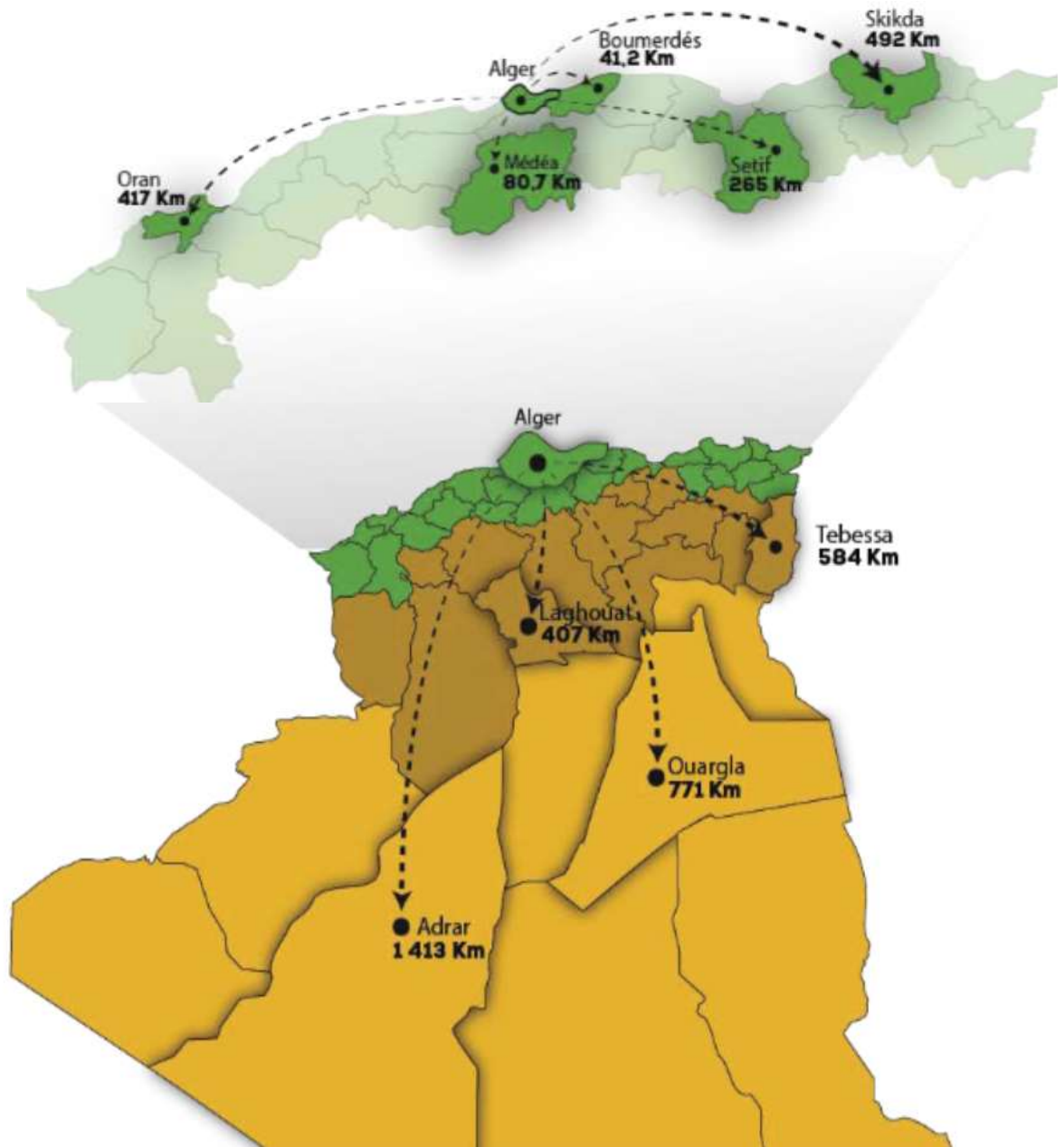


Figure 5 The wilayas sampled during the quantification campaign (National Waste Agency, 2022)

Wastes production by population is related to the number of inhabitants per household. (Fig.6) represents the amount of **DM**(household waste/déchets ménage) kg/day/inhabitant produced by the number of inhabitants per household .

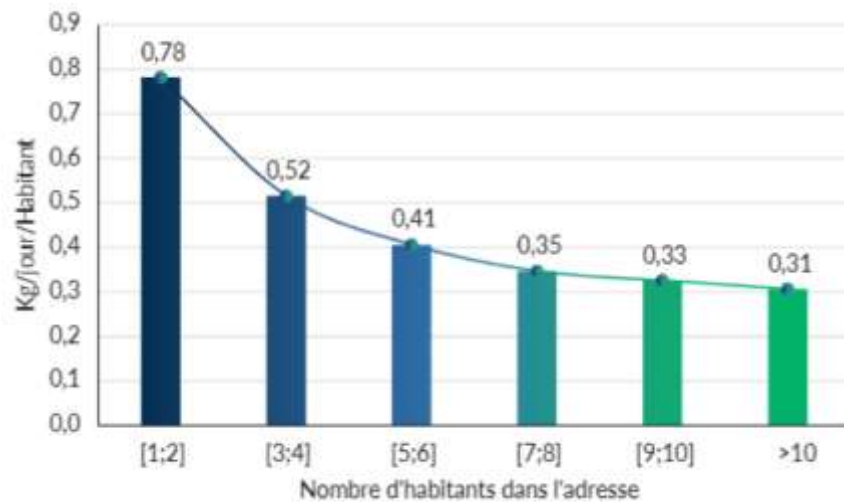


Figure 6 Ratio of household waste per number of people in the home (National Waste Agency, 2022)

We note that the fewer people there are per household, the greater the amount of DM generated and vice versa . This might be related to their better standard of life .



Figure 7 Daily variation in the household waste ratio (National Waste Agency, 2022)

(Fig.7) shows the daily generation of DM by days of the week . We note that it fluctuates according to the days in a non-negligible way, in particular between Friday and Monday. In fact, the highest amount of DM was recorded on Fridays (0.484 Kg/day/inhabitant) while the lowest was on Mondays (0.457 Kg/day/inhabitant). It can be related to the house cleaning activities usually taking place on Fridays in the Algerian society.

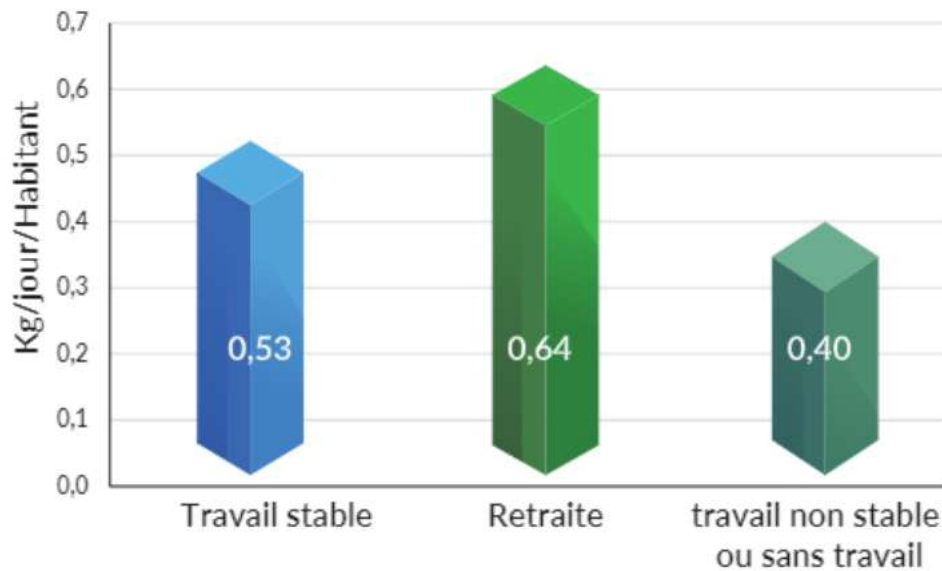


Figure 8 Ratio of household waste by professional status (National Waste Agency, 2022)

(Fig.8) shows the amount of DM (Kg/day/inhabitant) by professional status , we notice that retired families generate more DM 0,64 Kg/day/inhabitant compared to families with a stable job 0,53 Kg/day/inhabitant and families with no stable job or no job 0,40 Kg/day/inhabitant , this also could be related to a better standard of life .

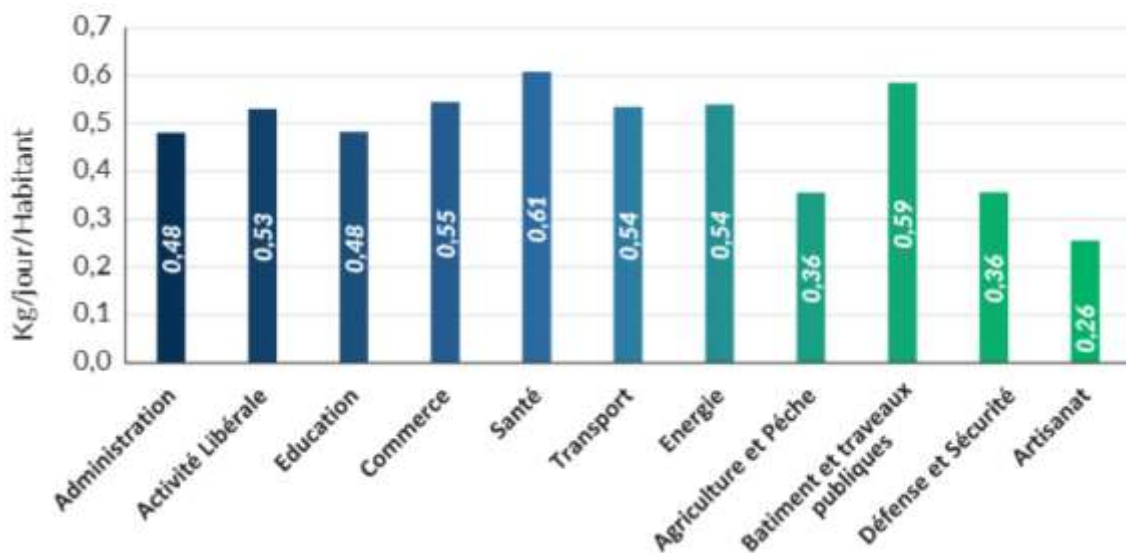


Figure 9 Average ratio of DM by field of work (National Waste Agency, 2022)

(Fig.9) shows the amount of DM (Kg/day/inhabitant) by field of work , we notice that there is a difference between the DM ratios according to the field of work, with the highest being healthcare 0,61 (Kg/day/inhabitant) and lowest being arts and crafts 0,26 (Kg/day/inhabitant) , this is probably due to the doctor profession being one of the highest paying professions in Algeria .

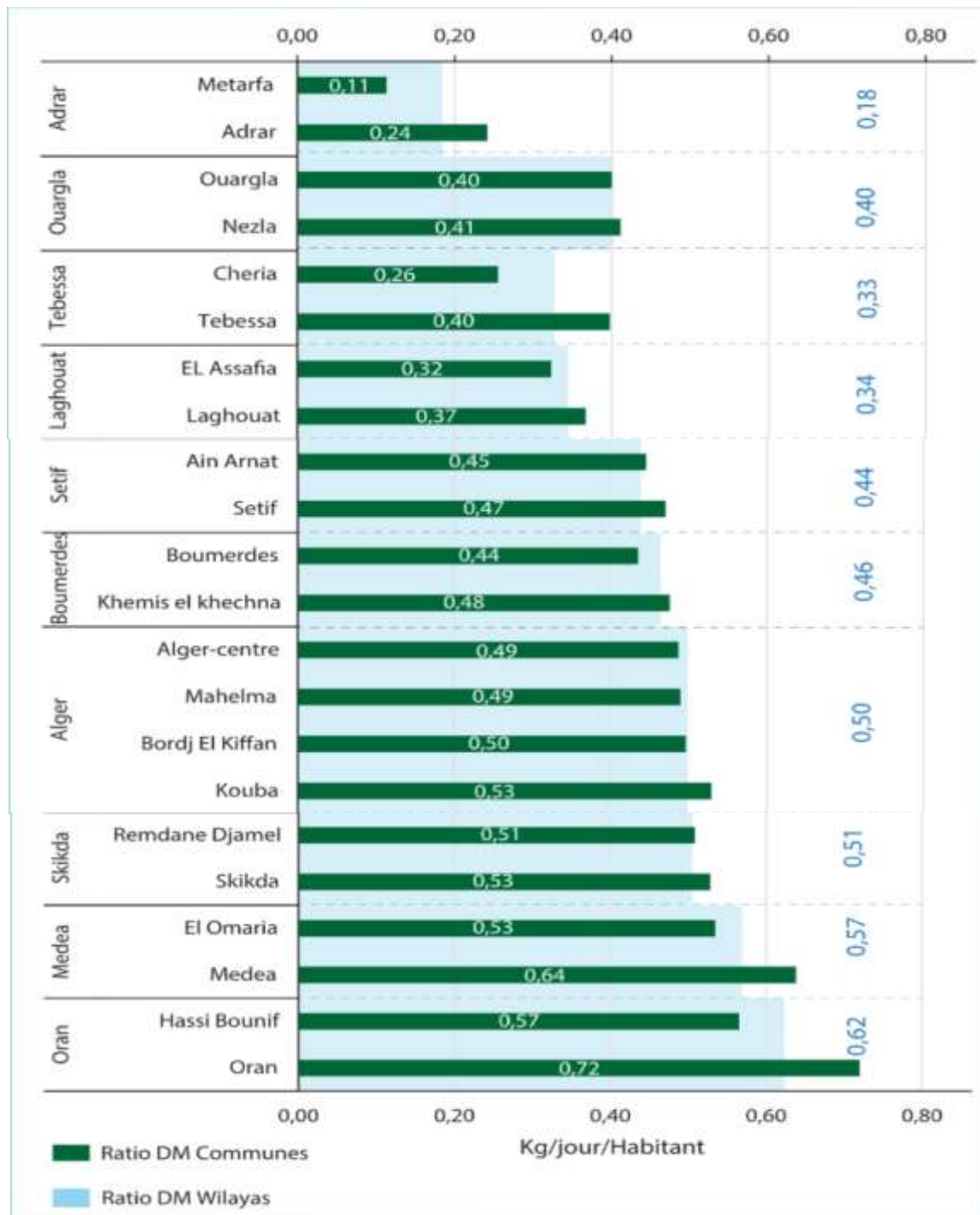


Figure 10 Ratio of DM generated by municipality (National Waste Agency, 2022)

(Fig.10) shows Ratio of DM generated (Kg/day/inhabitant) by municipality , we notice that the households of the chief towns of the communes generate quantities of waste higher than the other agglomerations , for example the wilaya of Oran , the chief town Oran generates 0,72 (Kg/day/inhabitant) while another municipality in the same wilaya Hassi Bounif generates 0,57 (Kg/day/inhabitant) ,this is due to the high density of the population and the concentration of the economic activities .

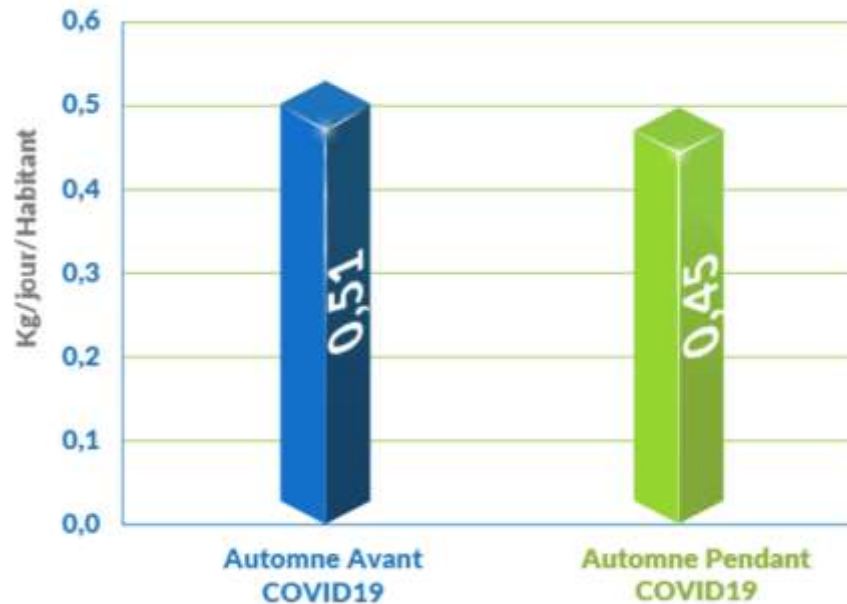


Figure 11 Ratio of DM before and during COVID19 (National Waste Agency, 2022)

(Fig11) shows the ratio of DM (Kg/day/inhabitant) before and during COVID19 ,where we notice a significant drop in said ratio , before it was 0,51 (Kg/day/inhabitant) and during COVID19 0,45 (Kg/day/inhabitant) , this is due to the lockdown situation that effected all business owners (stores, restaurants etc...)

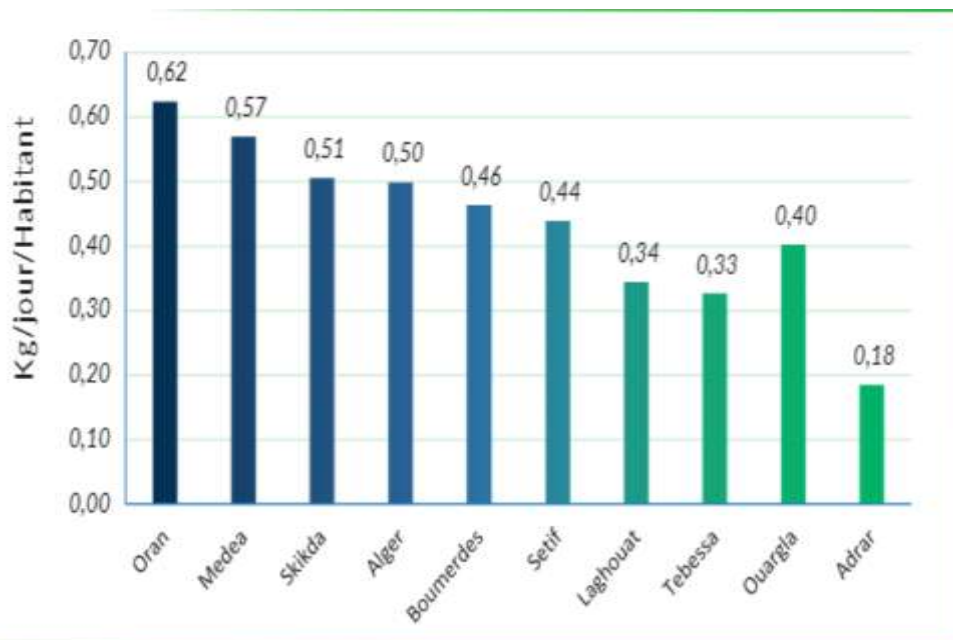


Figure 12 Ratio of DM generated by wilaya (National Waste Agency, 2022)

(Fig.12) shows the ratio of DM (Kg/day/inhabitant) generated by wilayas , we notice that the northern wilayas have a higher ratio than those of the south . for example Oran 0,62 (Kg/day/inhabitant) and 0,18 (Kg/day/inhabitant) , this is due to the difference in population density between north and south .

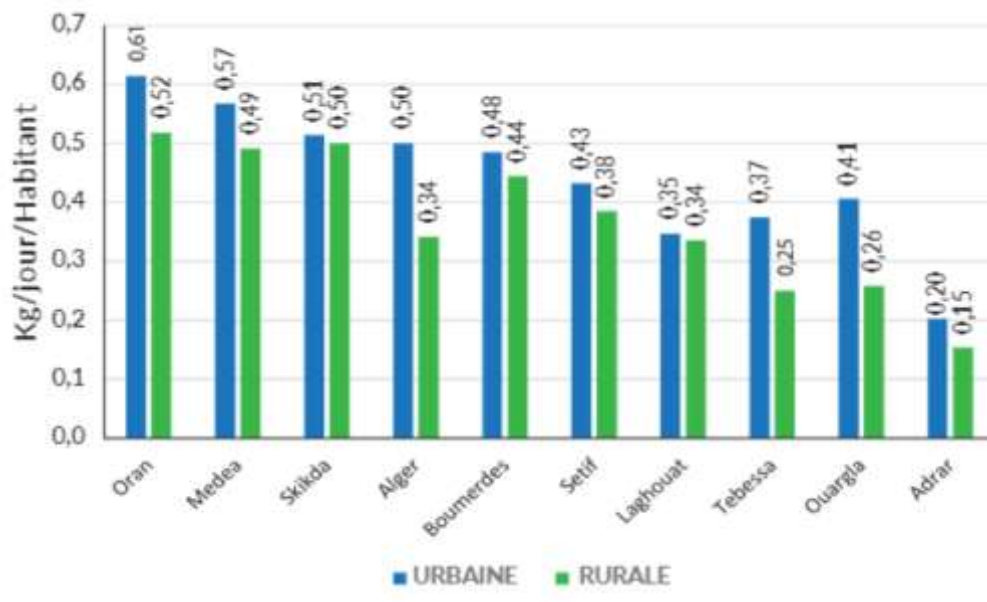


Figure 13 Generation of DM per day and per inhabitant according to the urbanization zone (National Waste Agency, 2022)

(Fig.13) shows generation of DM (Kg/day/inhabitant) according to the urbanization zone , we notice that the quantity of DM in rural areas is always inferior than that of urban areas , this is in all wilayas , for example urban Ouargla 0,41 (Kg/day/inhabitant) and rural Ouargla 0,26 (Kg/day/inhabitant) , this is due to the difference in population density .

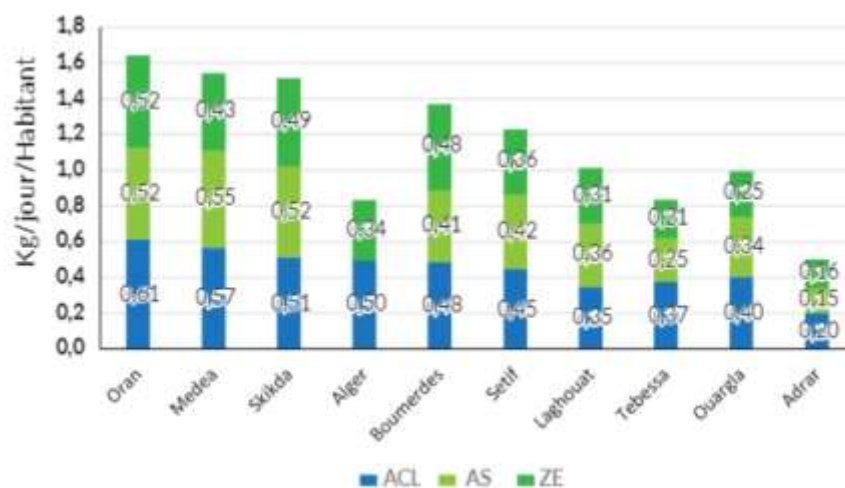


Figure 14 Generation of DM according to the type of agglomeration (National Waste Agency, 2022)

(Fig.14) shows the generation of DM (Kg/day/inhabitant) according to the type of agglomeration , we notice a slight difference between the ratios of DM, between the **ACL** agglomerations and the two other types of agglomerations (**AS** and **ZE**) except for the wilaya of Oran where the situation is more visible . in Oran we have : **ACL** 0,61 (Kg/day/inhabitant) , **AS** 0,52 (Kg/day/inhabitant) , **ZE** 0,52 (Kg/day/inhabitant) , this also due to the difference in population density .

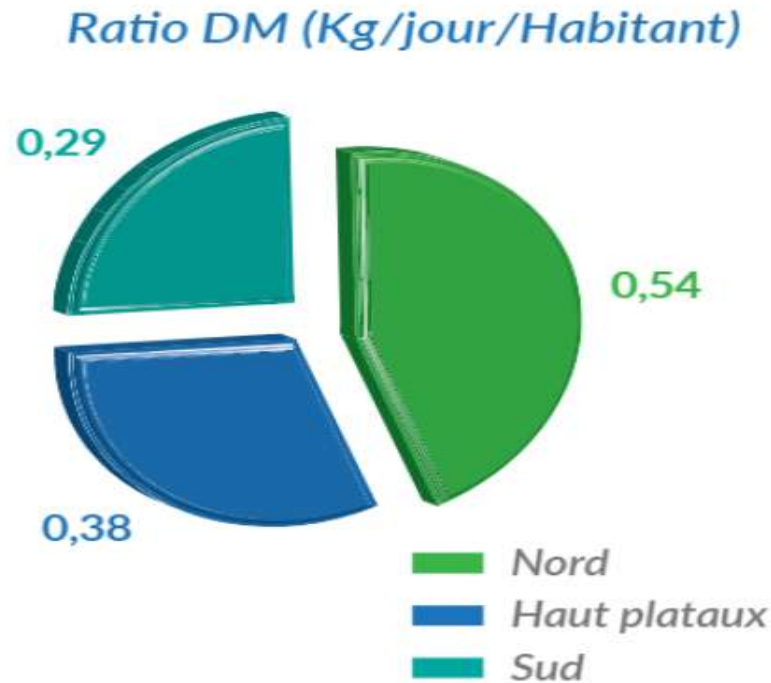


Figure 15 Generation of DM by region (National Waste Agency, 2022)

(Fig15) shows generation of DM by region , we notice that the quantity of waste from households in the northern region is notably higher compared to other regions with 0.54 kg/day/inhabitant followed respectively by the high plateau region with 0.38 kg/day/inhabitant and the southern region with 0.29 kg/ day/inhabitant . this is due to the population density .

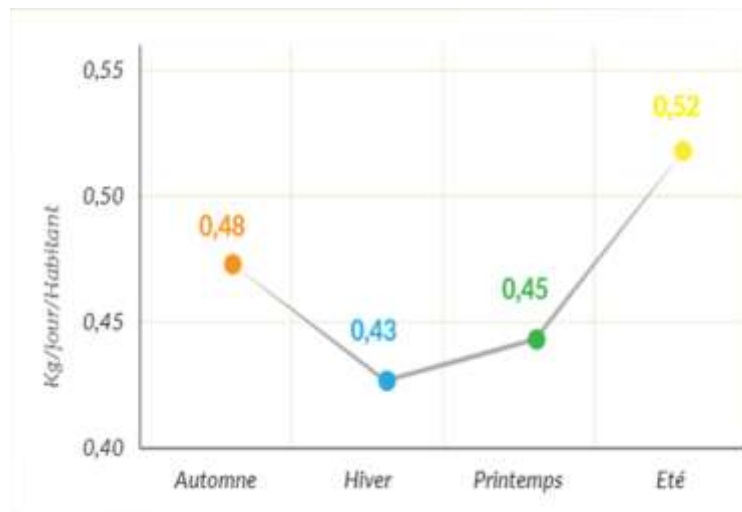


Figure 16 Evolution of the generation of DM by seasons (National Waste Agency, 2022)

(Fig16) shows evolution of the generation of DM (kg/day/inhabitant) by seasons , we notice that the generation of DM varies per season between 0.43 and 0.52 kg/day/inhabitant , with the lowest point being winter and highest being summer , this is probably because it's a holiday season (gatherings , parties etc...)

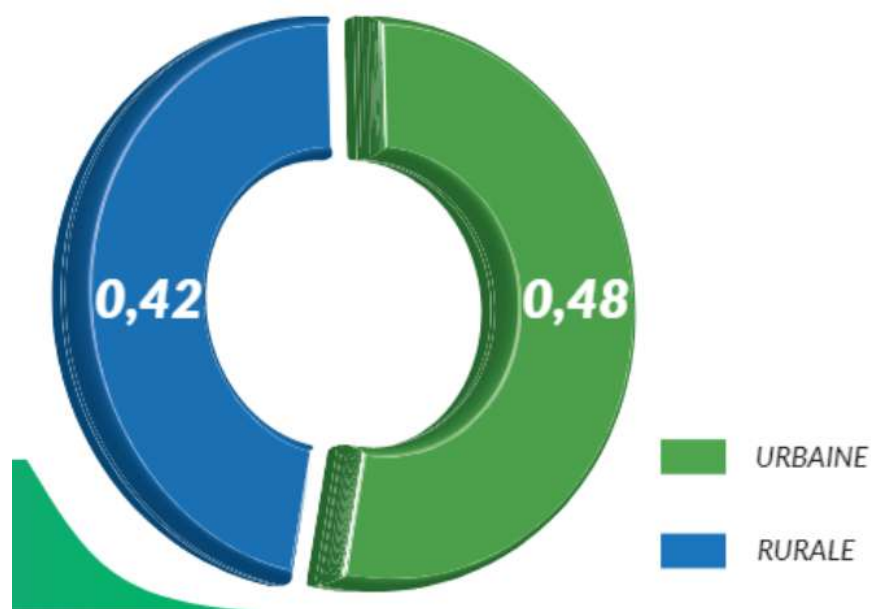


Figure 17 Generation of DM according to the habitat zone at the national level (National Waste Agency, 2022)

(Fig.17) shows generation of DM (kg/day/inhabitant) according to the habitat zone at the national level , we notice that in the urban areas the quantity of generated DM 0,48 (kg/day/inhabitant) is slightly greater than that of the rural areas 0,42 (kg/day/inhabitant) , due to the population density .

Ratio DM Kg/jour/Habitant

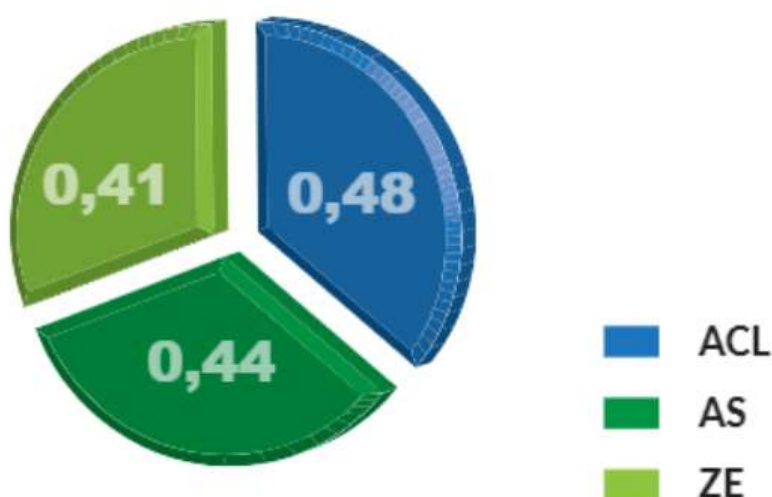


Figure 18 Generation of DM according to the type of agglomeration (National Waste Agency, 2022)

(Fig.18) shows generation of DM (kg/day/inhabitant) according to the type of agglomeration , we notice that there is a clear difference between the generation of DM between the **ACL** 0,48 (kg/day/inhabitant) and the two other types of agglomerations **AS** 0,44 (kg/day/inhabitant) and **ZE** 0,41 (kg/day/inhabitant). This difference can be attributed to the better living conditions in the **ACL** agglomerations than in the others (**AS** and **ZE**).

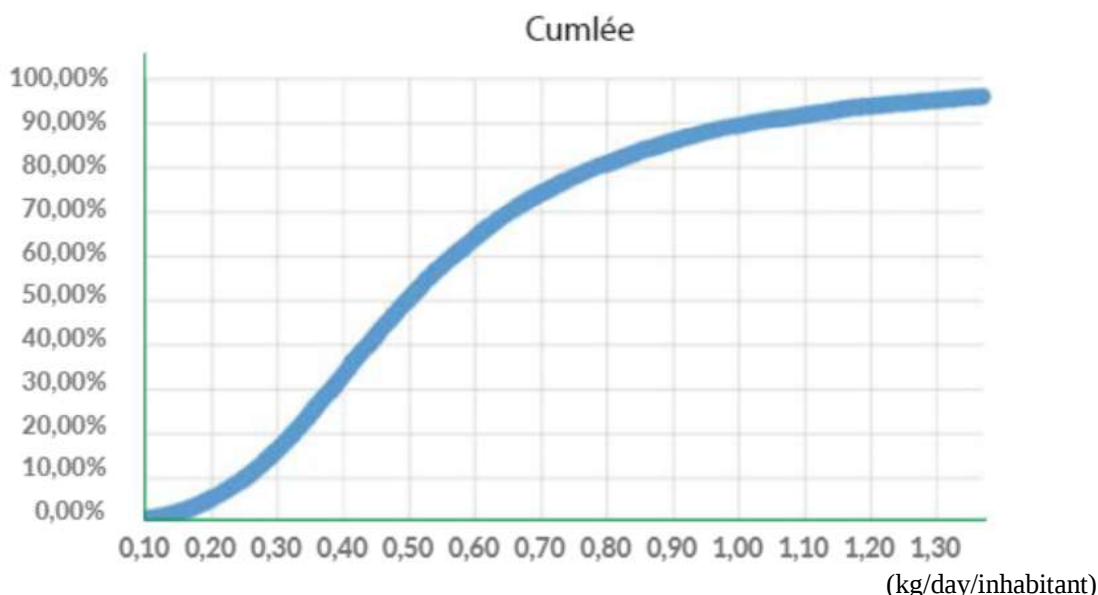


Figure 19 Pareto chart (National Waste Agency, 2022)

(Fig.19) shows the approximative percentage of the Algerian population (according to the sample size) by ratio of DMA generation (kg/day/inhabitant) , we can notice that the ratios 0.32 Kg/day/Inhabitant, 0.47 Kg/day/Inhabitant and 0.78 Kg/day/Inhabitant correspond respectively to 20%, 47% and 80% of the population , Consequently, the ratio of 0.78 Kg/day/Inhabitant corresponds to 80% of the population there for it is better to consider it as a more representative ratio of the total population of the country .

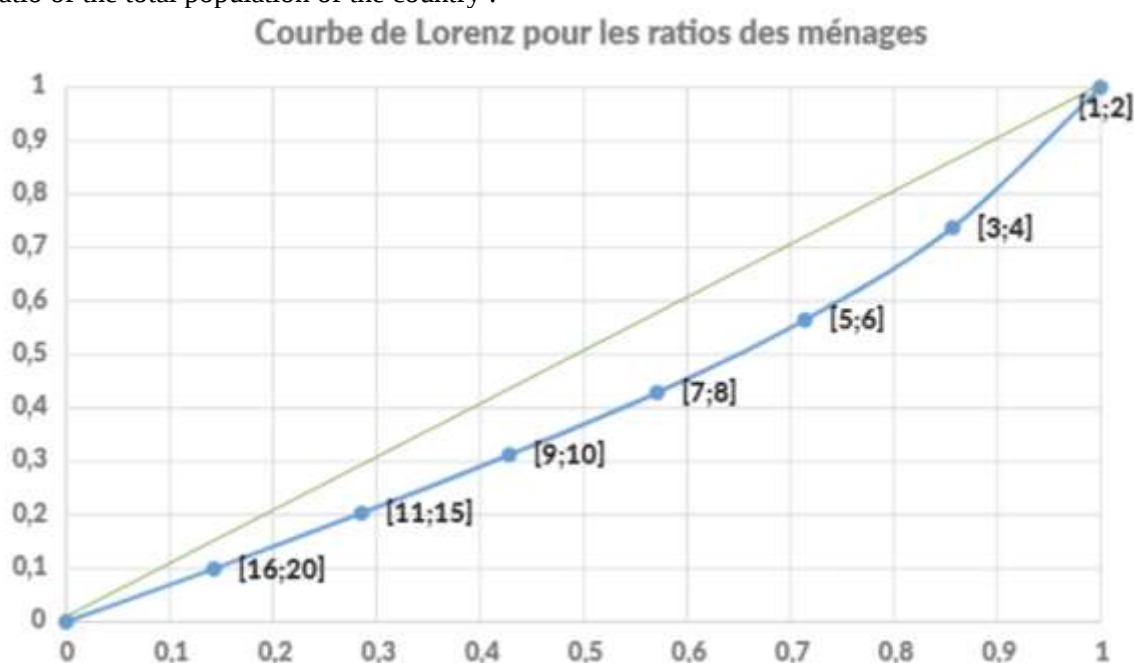


Figure 20 Lorenz curve for household ratios by family size (National Waste Agency, 2022)

(Fig.20) shows Lorenz curve for household ratios by family size , We distinguish from the figure above that families made up of 1 to 8 individuals, IE the intervals of [1-2]; [3-4]; [5-6] and [7-8], constitute 57% of the family intervals and they are responsible for approximately 69% of household waste (DM) generated. We also observe that the smaller the family, the more waste there is generated per inhabitant; a situation that is not valid for families made up of 9 people or more.

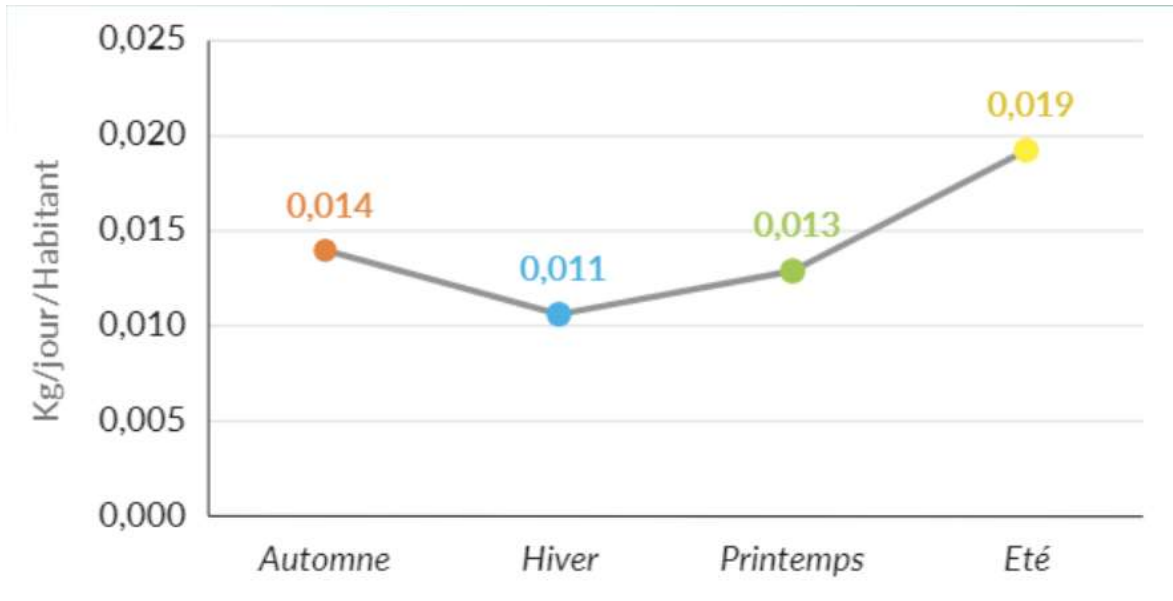


Figure 21 Seasonal evolution of bread purchased and not consumed (National Waste Agency, 2022)

(Fig.21) shows the Seasonal evolution of bread purchased and not consumed (kg/day/inhabitant), the daily quantity "ratio" of bread not consumed by households is on average 0.014 (kg/day/inhabitant), and it varies according to the seasons from 0.011 in winter to 0.019 in summer (kg/day/inhabitant) .

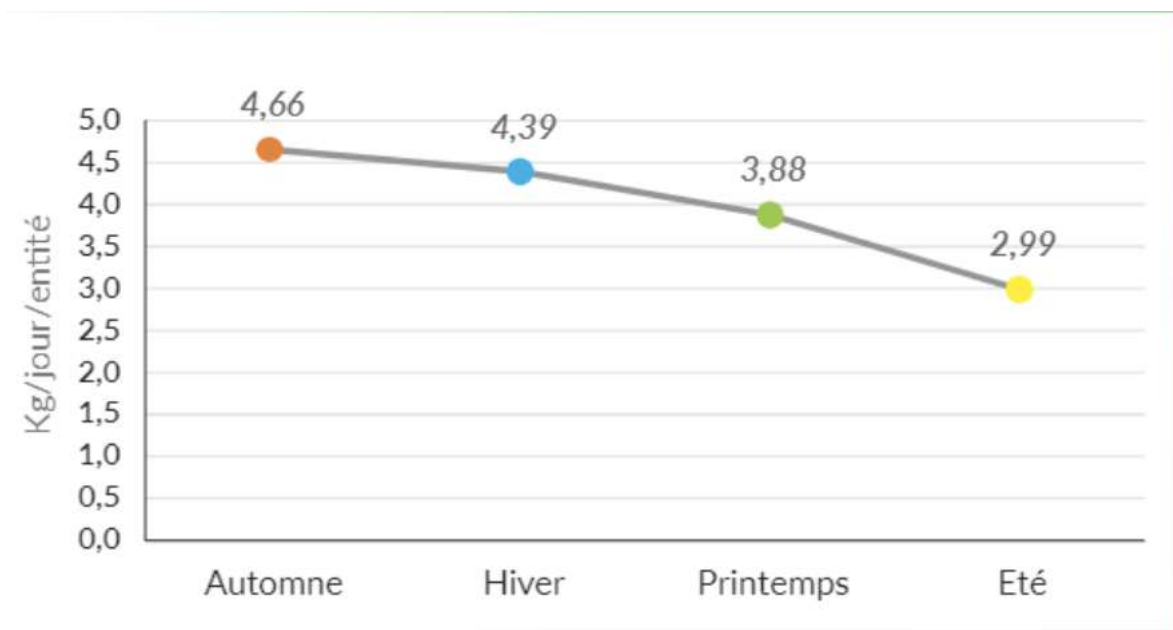


Figure 22 Evolution of the generation of DA from economic and administrative entities (National Waste Agency, 2022)

(Fig.22) shows the evolution of the generation of DA from economic and administrative entities , we can notice that the amount of DA waste generated per unit varies with the seasons , the maximum is recorded in autumn with 4.66 (kg/day/entity) and the minimum in summer with 2.99 (kg/day/entity). the ratio of AD generated is on average 4 (kg/day/entity) .

It should be noted that the study coincided with the outbreak of the COVID-19 pandemic, the confinement of people to their homes and the disruption of the functioning of economic and administrative entities, which explains this decrease in summer .



Figure 22 Annual variation of the ratio of DMA generated at the national level (National Waste Agency, 2022)

(Fig.23) demonstrates the Annual variation of the ratio of DMA generated at the national level , we notice that the average generation of DMA is estimated at 0.68 kg/day/inhabitant in 2021 and 0.67 kg/day/inhabitant in 2020. For the year 2019, it is 0.8 kg/day/inhabitant, the decrease recorded in 2020 is due mainly due to the appearance of the COVID-19 pandemic which has greatly disrupted the activities of economic and administrative entities and impacted the consumption of citizens in general .

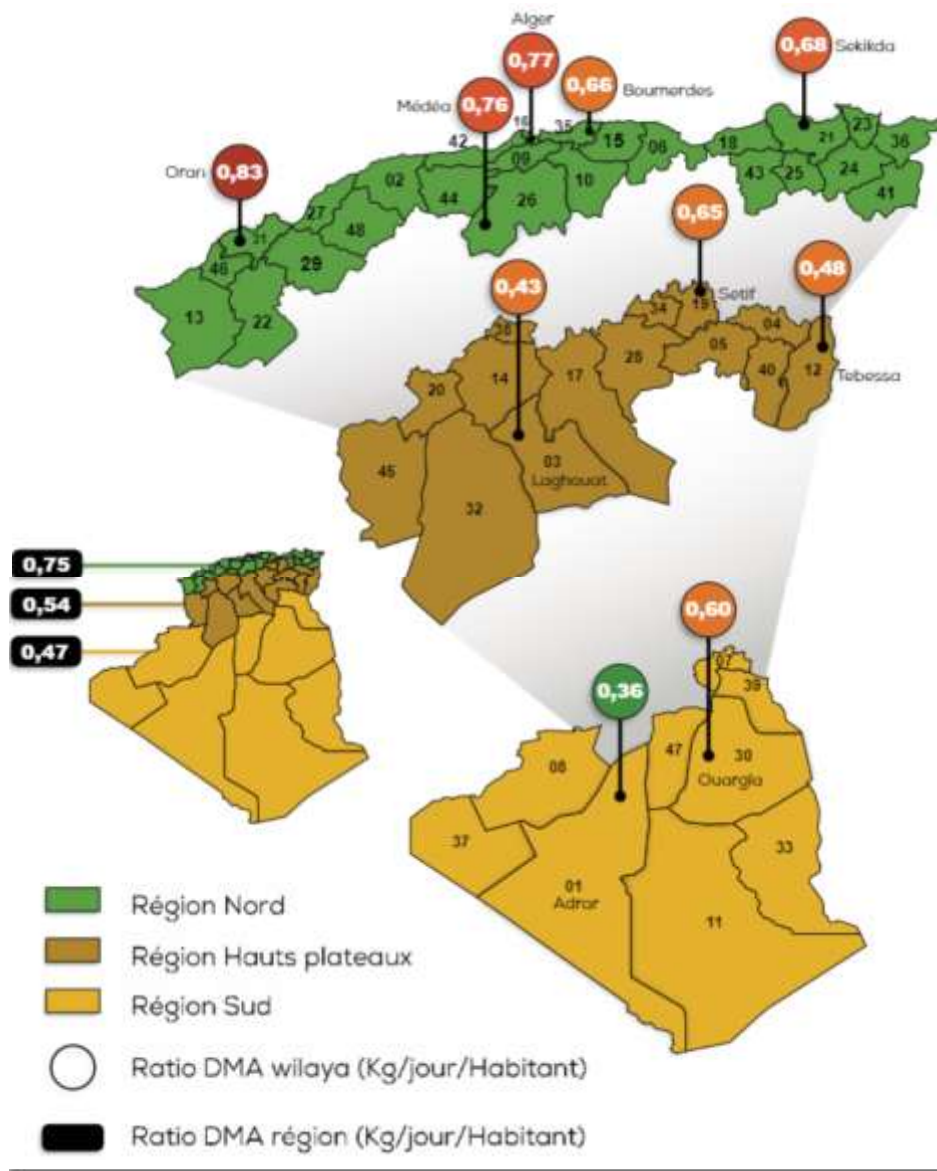


Figure 23 Ratio of DMA generated by wilayas and by regions (National Waste Agency, 2022)

(Fig24) shows the ratio of DMA generated by wilayas and by regions , It can be seen that the generation of DMA in the north of the country varies between two thresholds; 0.83 kg/day/inhabitant for the wilaya of Oran and 0.66 kg/day/inhabitant for that of Boumerdès. For the high plateau , the threshold is between 0.65 kg/day/inhabitant for the wilaya of Sétif and 0.43 kg/day/inhabitant for Laghouat. Concerning the great south, the difference is more accentuated, the generation of DMA is 0.60 kg/day/inhabitant in the wilaya of Ouargla and 0.33 kg/day/inhabitant

for that of Adrar , (Fig.24) gives an overview of the generation of DMA at the level of the three areas of the country .

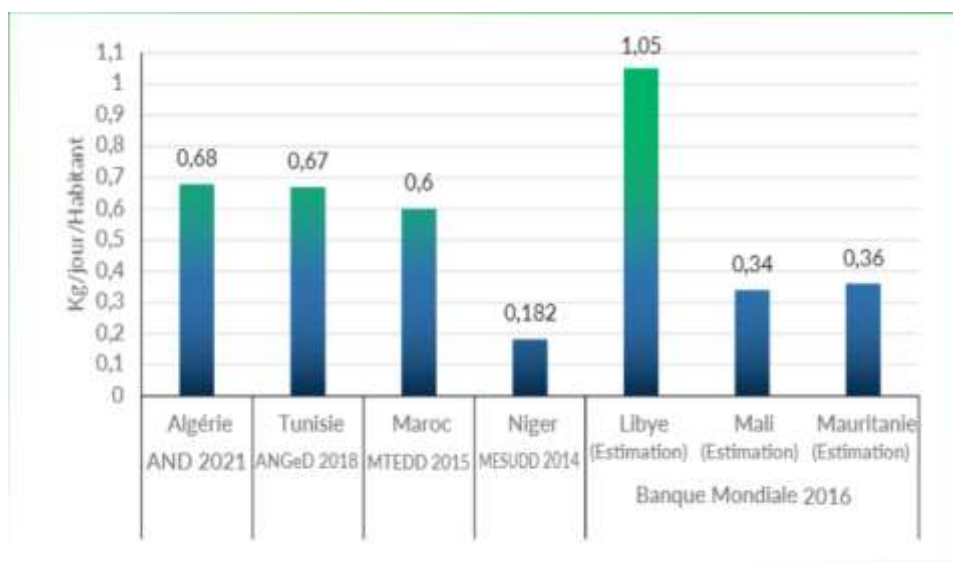


Figure 24 Ratio of DMA generated in Algeria and these bordering countries (National Waste Agency, 2022)

(Fig.25) shows ratio of DMA generated kg/day/inhabitant in Algeria and these bordering countries In comparison with neighboring countries, it can be seen that the generation of DMA per day and per inhabitant is comparable with that of Morocco 0,6 kg/day/inhabitant and Tunisia 0,67 kg/day/inhabitant . The three countries are located on the same geographical band and have similar climatic, economic and cultural characteristics. The other sub-Saharan countries generate much less DMA for example Niger with the least DMA ratio 0,182 kg/day/inhabitant . and we notice that Libya ha the highest DMA ratio 1,05 kg/day/inhabitant .

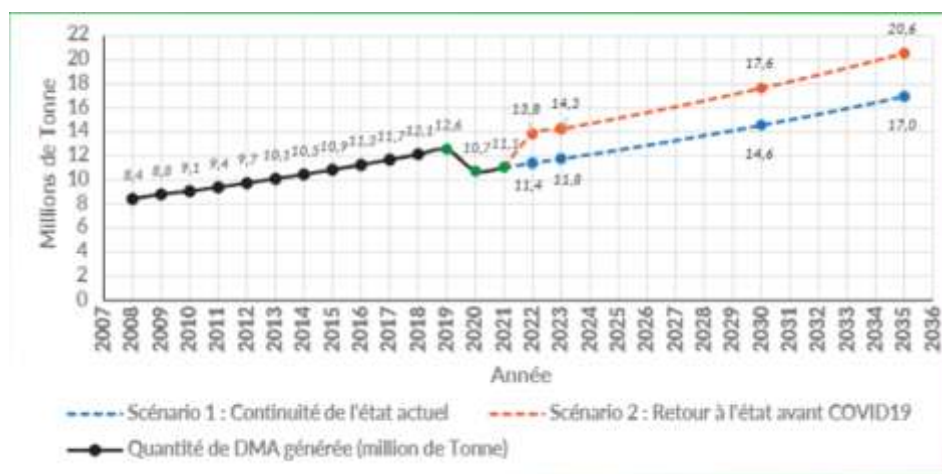


Figure 25 Evolution of the generated quantity of DMA annually (National Waste Agency, 2022)

(Fig.26) shows evolution of the generated quantity of DMA (Million ton) annually , the quantities of DMA generated estimated during 2019,2020,2021 are as follows ,
In the Year 2019 : 12.6 Million tons , the Year 2020 : 10.7 Million tons , and the Year 2021 : 11.1 Million tons.

In view of this curve, the quantity of DMA generated was 8.4 million tons in 2008 and 12.6 million tons in 2019. It is thus estimated that the quantities of DMA generated for the years to come are as follows , in the Year 2022 : between 11.4 and 13.8 million tonnes , theYear 2023: between 11.8 and 14.3 million tons , the Year 2030: between 14.6 and 17.6 million tonnes , and theYear 2035:

between 17.0 and 20.6 million tonnes .

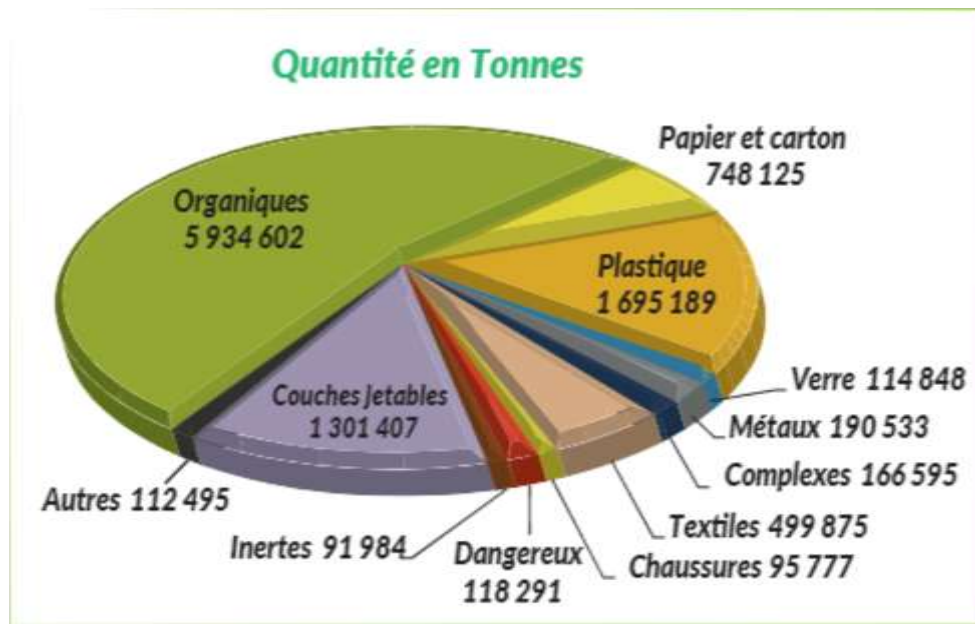


Figure 26 Quantities of DMA generated by waste category (National Waste Agency, 2022)

(Fig.27) this is an estimation done by the AND on the quantities of DMA generated by waste category ,we can notice that the majority of DMA generated is organic with almost 6 mill tones followed with plastic with around 1.7 mill tons and disposable diapers at 1.3 mill tons , and inert waste as the lowest at 91984 mill tons . organic waste is that high due to food being the most popular type of waste .

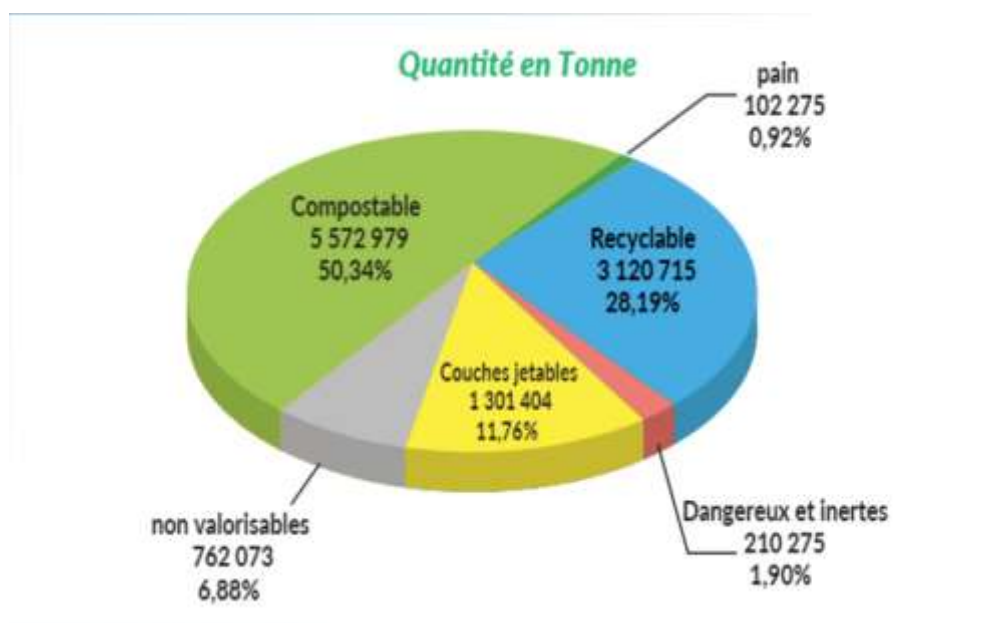


Figure 27 Quantities of DMA generated by waste recovery method (National Waste Agency, 2022)

(Fig.28) shows the Quantities of DMA generated (mill tons) by waste recovery method . For the year 2021, nearly 80% of DMA can be recovered, of which more than 50% (5.6 million tons) can be composted or methanized and more than 29% (3.2 million tons) can be recycled. For the rest of the DMA, approximately 2.2 million tons cannot be recovered for the moment, however, in the future, they could be reduced through targeted measures such as incineration and/or the

creation of new recycling channels. (National Waste Agency, 2022)

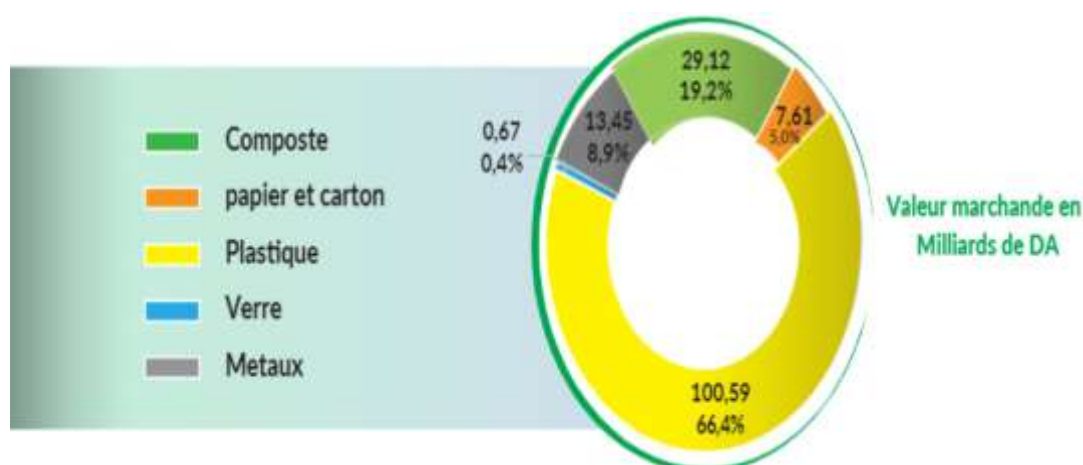


Figure 29 Market value of recoverable DMA by type of material (National Waste Agency, 2022)

(Fig.29) The market value of recycled glass is the lowest with 0.67 billion DA, because the latter represents only 0.87% of DMA. The market value of compost is 29.12 billion Dinars and represents a rate of 19% compared to the total market value of DMA . Plastic has the highest market value with 100.59 Billion DA, which represents 66% of the total market value of DMA, because on the one hand the prices of plastic are quite high and on the other hand it constitutes a proportion importance of DMA .

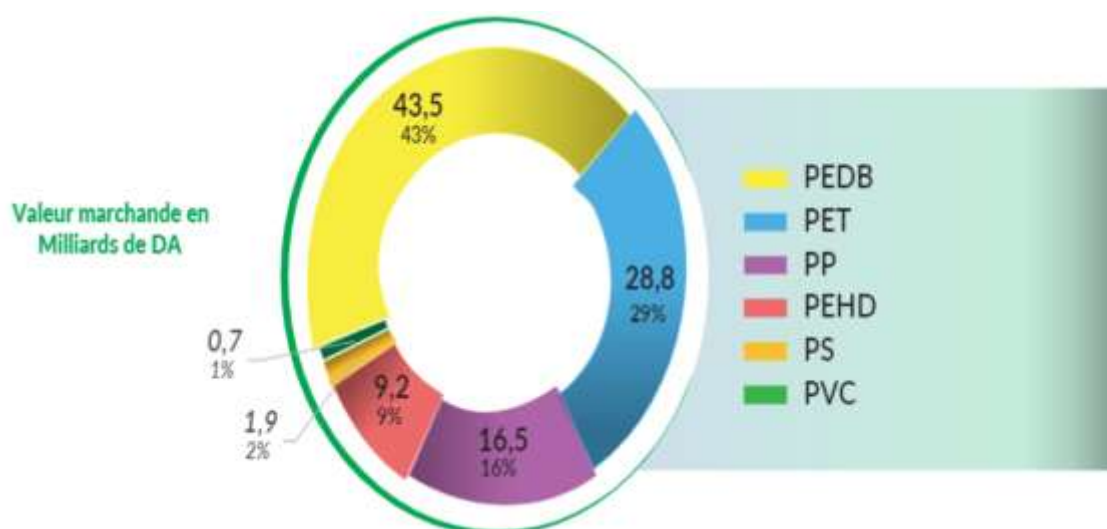


Figure 28 Market values of recoverable plastic DMA by types (National Waste Agency, 2022)

(Fig.30) The types of plastics that have the highest market values are **PEDB** with 43.5 billion Dinars and **PET** with 28.8 billion Dinars. The latter have a preponderant share in the plastics market. **PP**, **HDPE** and **PS** have significant market values which are respectively 16.5 billion dinars, 9.2 billion dinars and 1.9 billion dinars.

PVC has the lowest market value with 664 Million Dinars, not exceeding not 1% of the total market value of plastics because of its scarcity in DMA.

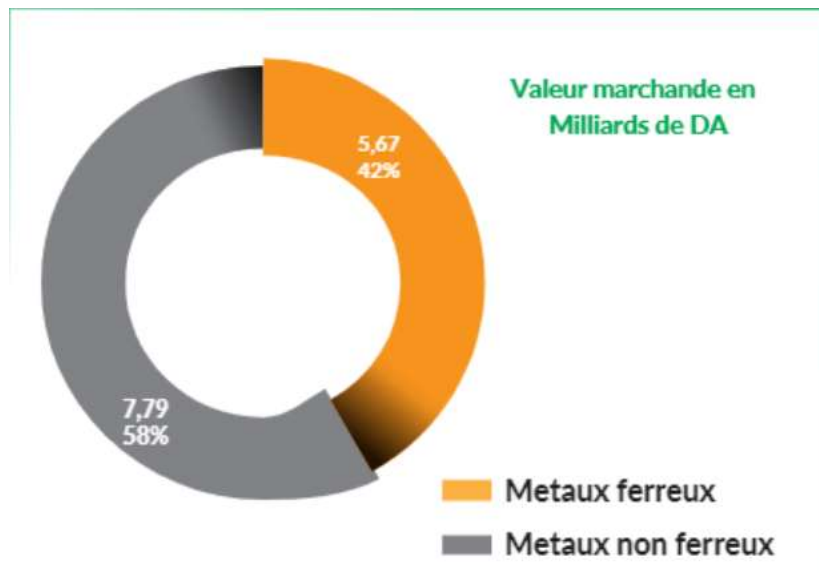


Figure 29 Market values of recoverable metal DMA by type (National Waste Agency, 2022)

(Fig.31) Regarding ferrous and non-ferrous metals, we notice from the figure above that the latter has a slightly larger market value than the former, the combined market value of the two represents 13.45 billion DA, it is significantly higher than that of paper/cardboard which is 7.61 billion DA which can be seen in (Fig.29).

3.3. An example of AND accomplishments (Oued S'mar projetct) :

Boudibi Ilias service manager working for the directorate of ENGINEERING stated all of the following:

Oued S'mar dump was the biggest dump in Algeria and one of the biggest in Africa ,it received 2500 tons of waste daily , it stacked up to reach 50 meters in height (all types of waste household , commercial ,industrial ,hospital and cleaning products ...) , waste coming from the capital municipalities and surrounding regions , for more than 30 years this dump was a source of nuisance and pollution , a real threat to public health , plus the deterioration of agricultural land surrounding the site .

The landfill is located in the middle of the eastern suburbs of Algiers, in the municipality of the same name, Oued Smar. it effected the inhabitants and several neighboring municipalities due to the irritating smell and the air pollution that negatively effected the public health and was a cause in the spread of disease.

After its opening in 1978 this landfill took over 45 hectares of polluted land, it gathered 9 million tons of waste that released around 480 m3 of leachate daily into the environment.

The project of closing and rehabilitating the main landfill in Oued Smar is part of the national strategy that aims to eliminate environmental pollution resulting from these landfills



Figure 30 Oued Smar dump before rehabilitation (Wansi, 2022)



Figure 31 Oued Smar dump after rehabilitation (ZEHRAOUI, 2022)

The project was implemented in two main phases:

First phase of the study: Began in 2006 and is represented in the demographic survey of the region, the geological and climatic study, knowing the amount of biogas produced from the waste by drilling wells, and the evaluation of the pollution resulting from the leachate

Second phase includes 6 steps:

- Excavation and reburial of exposed waste.
- Construction of wells for pumping biogas and leachate.
- Construction of a drainage system to recover biogas emitted from waste and leachate.
- Covering waste with various insulating and non-permeable layers.
- Building infrastructure for biogas treatment and leachate.
- Building the public park and maintaining its cleanliness.



Figure 32 Biogas and leachate pumping well (Benaissa, 2023)

It took six years to begin to see the park in its current form, the first excavations started in 2010. the dump was partially still active until 2012 when it was fully closed. once the waste was stabilized a layer of inert earth (clay) was put directly above the waste, then a layer of geomembrane, then a second layer of clay, and finally layer of topsoil and a plantation (with 617000 plants from 27 different species).

127 wells where built to extract the biogas and leachate, in 2013 the treatment station of biogas and leachate was built,

Biogas treatment:

Biogas consists of multiple gases CH_4 , O_2 , CO_2 , traces of H_2S etc... there are 2 outcomes of the treatment process:

- 1/If the concentration of CH_4 is above 45% the biogas will be used to generate electricity for the park through cogeneration if the concentration is lower than 45% it goes through the regulation plant to try and bring the O_2 concentration down and CH_4 up above 45% ,
- 2/If the first process is not successful biogas is dealt with in the incineration plant, where flammable or toxic gas compounds are converted into inert or non-toxic compounds.



Figure 33 Electricity Cogenerator (Benaissa, 2023)



Figure 34 Incineration plant (Benaissa, 2023)



Figure 35 Incineration plant (Benaissa, 2023)

Leachate treatment :



Figure 36 Leachate basins (Benaissa, 2023)

At the beginning of this process, leachate is carried directly from the basin designated for it to the primary filtration unit. This is in order to get rid of impurities and solids. It is then transferred to a special tank for the purpose of adding sulfuric acid, and this is to lower the pH of the liquid.

After that the leachate is transferred to the pre-treatment unit and it is done through several sand filters.

Following that, it will be transferred to the treatment unit through high-pressure membranes, which results in two substances:

The first being the treated leachate which poses no threat to the environment, it's transferred directly to storage tanks for reuse.

The second one is concentrated leachate; it is treated once more before it's stored in special tanks.



Figure 37 Leachate treatment unit (Benaissa, 2023)

The total capacity of this station is around 720 m³ daily.

In parallel with the treatment process, and since 2014, the establishment of the urban garden began in order to integrate and coordinate the garden with its immediate environment, in this case the agricultural character of the region and its proximity to city life. In addition to the establishment of an urban garden in accordance with environmental standards and the eradication of one of the largest landfills in Algeria, the rehabilitation allowed the economic recovery of the entire area, whose attractiveness had severely deteriorated during the years of operation of the landfill. These advantages allowed the agriculture adjacent to the park to regain its vitality and productivity. not to mention improving the environmental and health quality of the population.

CONCLUSION

Conclusion

Throughout this work a lot has been learned about the challenges and strategies involved in waste management, the importance of promoting green economy initiatives, and the significance of engineering solutions in tackling environmental issues. My internship has highlighted the dedication and commitment of the AND in addressing waste management concerns in Algeria.

The AND is responsible for promoting waste sorting, collection, transport, treatment, Recovery and disposal activities, through the actions of:

Gathering and sharing data about waste and waste management.

Spreading awareness among the population.

Advocating for green/circular economy.

In addition to performing countless field missions such as the closing and rehabilitation of illegal waste dumps.

It seems that the state of indifference taken by the majority of the Algerian people towards waste is slowly improving due to the relentless efforts of organizations like AND, and people who genuinely care about the environment and the economical backlash of an imbalanced one.

Finally the key to all environmental problems lies in public awareness and knowledge it boils down to the family the father and mother, educating their children and teaching them what's right and what's wrong, where to throw that plastic bag and where not to throw it .

We believe that the insights gained during the internship at AND and the making of this dissertation will not only benefit me as a student but will also contribute (be it on a miniscule scale) to the ongoing efforts in waste management and sustainability in Algeria.

We look forward to applying the knowledge and skills We have gained to make a positive impact in the field of waste management in the future.

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