Household Solid Waste Production and Composition in the Al Haouz Province, Morocco

Robert Eastman Johnson

U.S. Student Fulbright Researcher

2018-2019

Table of Contents

Table of Contents 2

List of Abbreviations 3

List of Figures 4

List of Tables 5

Introduction 1

Methodology & Organization 2

Morocco 3

Government Development Programs 4

National Sustainable Development Strategy (2017-2030) 4

National Household Solid Waste Management Program (PNDM) 5

National Reports and Studies on Solid Waste Management 6

Summary 8

Al Haouz Province 9

Al Haouz Province Master Plan for Household Solid Waste 13

Research Findings 14

Total Household Solid Waste Generated 15

Solid Waste Transfer Stations 19

Solid Waste Composition 23

Conclusion 27

Appendices: Surveys Distributed 28

Appendix A: Context Survey 29

Appendix B: Plastic Bottle Survey 29

Appendix C: Cardboard and Carton Survey 30

Works Cited 32

List of Abbreviations

CEV: Marrakech Landfill and Recovery Center

COP22: 22nd Conference of Parties

GIZ: German Society for International Cooperation

HSW: Household Solid Waste

MEMEE/DE: Ministry of Energy, Mines, Water, and the Environment (Environmental Branch)

MOI: Ministry of the Interior

NSDS: National Sustainable Development Strategy

PNDM: National Household Solid Waste Management Program

SDGs: Sustainable Development Goals

AGR: Annual Growth Rate

L: Liter

ml: Milliliter

T: Metric Tonnes

List of Figures

Figure 1: Map of the Administrative Organization of the Al Haouz Province 9

Figure 2: Map of the location of the transfer stations, their quadrants served, and the annual household solid waste production in 2014 for each municipality 22

List of Tables

Table 1: National Solid Waste Produced Per Year 7

Table 2: Solid Waste Production Per Person by Population Size 8

Table 3: List of the Administrative Organization of the Al Haouz Province 10-11

Table 4: Estimated Population and Annual Growth Rate (2020) 11-12

Table 5: Daily HSW Produced in the Al Haouz Province 15-17

Table 6: Yearly HSW Produced in the Al Haouz Province 17-19

Table 7: Transfer Station Quadrants and Tonnage Produced (2020 & 2040) 20-21

Table 8: Total Tonnage Produced by Each Quadrant (2020 & 2040) 22-23

Table 9: Solid Waste Composition in Morocco and the Al Haouz Province 23

Table 10: Daily Solid Waste Composition in the Al Haouz Province (2020) (T/yr) 24-25

Table 11: Yearly Solid Waste Composition in the Al Haouz Province (2020) (T/yr) 25-26

Introduction

Over the past 20 years, the Kingdom of Morocco has slowly built its reputation as an advocate for sustainable development by hosting the 22nd Conference of Parties (COP22) in 2016, implementing incubators to incentivize micro, small and medium-sized enterprises to encourage the growth of a "green economy". Another way the Kingdom is promoting sustainability is through the establishment of several government programs and policies. These programs have begun the movement of national and provincial master plans, and local programs and workshops to prepare the country with basic infrastructure, education about the Sustainable Development Goals (SDGs), and ways to provide entrepreneurial opportunity for the enormous youth population.

This growing interest in development and the environment is no coincidence, with the rapid population increase and urbanization, the production of household solid waste increases as well. Unfortunately, the implementation of proper infrastructure doesn't occur as quickly as policies and programs. Infrastructure is more so the product of these government interventions; with them come meetings, analyses and data gathering, reports, and finally, proposals. Morocco has just begun finishing reports, with project priority on the urban centers.

The proliferation of illegal landfills, the low collection rate, the non-existence of treatment and recovery facilities, and above all, the lack of responsibility of generators of different types of waste, are all indicators that reveal the state of insufficiency in the household and similar waste sector. The lack of treatment and recovery facilities create an opportunity for innovative solutions for recycling and upcycling waste for rapidly growing semi-rural communities on the periphery of urban areas.

In order to propose such investments, one must understand the overall composition of the waste being produced, and what materials can be recycled and reused instead of being sent to the

landfill. This is the purpose of this report, to determine the amount of household waste produced and its composition in 2020, specifically, in the Al Haouz province.

Methodology & Organization

In order to first begin to understand the nature of household solid waste in the context of Morocco, I began a literature review of the most current government programs and master plans. I first analyzed the national programs that are directly addressing strategies for encouraging sustainable development, improving solid waste management and the regulatory framework in which they are operating.

Once this understanding was established, I found the most up to date reports on solid waste for Morocco and for the Al Haouz province. I obtained an electronic copy of the Al Haouz Master Plan for Household Solid Waste after meeting with the Director, Mr. Nourredine Bouchtammchte and Co-Director, Mr. Karam Amzil and discussing with them my research project and my master's thesis project for producing a waste-powered pottery kiln in Tameslouht. These reports made any physical data that I had collected up to that point, obsolete.

After summarizing the programs and reports relevant to household solid waste, I began to focus on manipulating the data found in the reports to produce data that adequately and confidently answered my initial research questions. Those questions being:

1. How much household solid waste is produced in the Al Haouz province in 2020?
2. What is the composition of the solid waste produced in the province?

The initial methodology was distributing surveys to local stores (*hanuts*) to determine the amount of plastic products sold, carton products distributed, and cardboard boxes received. The objective was to estimate the amount of solid waste from economic activities which can be assimilated to household waste. The focus areas of the research were the three "urban municipalities" and the five "urban centers" in the Al Haouz province: Ait Ourir, Amzimiz, Asni,

Tahanaout, Tameslouht, Moulay Brahim, Lalla Takerkoust, Sidi Abdellah Ghiat, and Ghmate. The surveys distributed can be found in the appendices.

Morocco

Currently, it is estimated that Morocco's total population is approximately 36.9 million people (Morocco Population 2020 (Live)). According to the 2014 Census, 47.2 percent of the population was under the age of twenty-four. This statistic shows that the population will continue to increase at rapid rates with the aging of this demographic. Therefore, it is important for the country to counter this growth with proper infrastructure, both social and physical.

In recent years, officials have recognized the importance of controlled waste management. In 2011, Morocco adopted the National Charter on Environmental and Sustainable Development followed by the New Moroccan Constitution reform the existing constitution in favor of the institutionalization of sustainable development. Allowing it to be easier for cross-departmental collaboration between the various governmental actions, civil society, and economic actors. At the same time, the National Household Solid Waste Management Program (PNDM) was implemented by the Ministry of the Interior (MOI) and the Ministry of Energy, Mines, Water, and the Environment (the environmental branch) (MEMEE/DE). One of the objectives of the PNDM concerns the development of master plans for the management of household waste for all the prefectures and provinces of the kingdom.

Morocco's efforts have been amplified after hosting COP22 in Marrakech in November of 2016. COP22 is part of the Paris Agreement's initial three-year action plan to begin the foundation for future projects. This international, multilateral collaboration helped establish multiple more international initiatives for Morocco, including the Marrakech Investment Committee for Adaptation Fund, Marrakech Partnership for Global Climate Action, the Marrakech Action

Proclamation for Climate and Sustainable Development, and others that support the investment of Morocco's future "green economy".

As time moves farther away from COP22 and the plans that were initially outlined, Morocco has kept on track by establishing supportive programs and start-up incubators for "green economy" related projects as planned for in 2011. These reformations and initiatives set up the creation of the 13-year National Sustainable Development Strategy (NSDS) for 2017 to 2030 to assist in transitioning to a "green economy".

Government Development Programs

National Sustainable Development Strategy (2017-2030)

The NSDS anticipates a successful transition to a "green economy" by 2020. The definition of "green economy" is a new economic paradigm still focused on the facets of sustainable development of economy, social, and culture, but also finally introducing the environment into the equation.

For governments, this would mean continuing to establish new rules that would be more favorable to ecological products, in order words, progressively letting go of subsidies, reforming policies, adopting new incentive-building measures, strengthening market infrastructure and economic mechanisms, redirecting public investment and "greenifying" government contracts.

In the public sector, this would entail analyzing new business strategies and start-ups that can creatively capitalize on the transition toward a "green economy" in a variety of sectors, and to react strategically to the anticipated policy reforms and market by increasing their levels of funding and investment in these upcoming markets.

The strategies identified to approach the implementation of NSDS are broken down into seven major tasks, each task is then divided into strategic focuses that consist of their own objectives and suggested action plans. The seven tasks are as follows:

1. Consolidate Sustainable Development Governance
2. Successful Transition to a "Green Economy"
3. Improving Natural Resource Management and Development and Strengthening Biodiversity Conservation
4. Accelerate Implementation of the National Policy Concerning the Fight Against Climate Change
5. Grant Special Vigilance to Sensitive Territories
6. Promote Human Development and Reduce Social and Territorial Inequalities
7. Promote the Culture of Sustainable Development (Kingdom of Morocco 2016, 12)

The "green economy" concept does not replace sustainable development, it is complementary to providing a more viable economic approach that is in alignment with the SDGs. Decades of wealth creation with the "brown economy" model have been consistent with marginalizing groups and also depleting resources. Sustainable development remains a long term and vital objective, but only in conjunction with greening of the economy. To date, this process has resulted in the integration of sustainable development principles into addressing different sectorial strategies, such as the implementation of the Strategy for Upgrading the Environment and the National Initiative Human Development ("Environment" 2013).

National Household Solid Waste Management Program (PNDM)

In 2003, Morocco was in desperate need for reformation of modernizing the waste management sector with a stronger legal and institutional framework. Rapid urbanization has led to significant negative economic, environmental and social impacts in municipal areas. To address these problems, the government initiated the reform of the waste sector with the adoption of the first Solid Waste Law in 2006 (Law No. 28-00) promulgated by Dahir No. 1-06-153.

The government then approved the fifteen-year, three-phase PNDM in 2007, but the program was not implemented until 2009 when the World Bank helped to provide the necessary

regulatory framework for establishing the foundations for integrated and affordable municipal solid waste management systems by giving two loans equaling $271.3 million USD (PNDM 2012).

The overall objectives of the PNDM are as follows:

- "Ensure the collection and cleaning of household waste to reach a collection rate of 100% in 2030;
- Ensure access to controlled landfills for household and similar wastes for all urban centers (100%) by 2022;
- Rehabilitate or close existing storage sites (100%) by 2022;
- Modernize the waste sector by increasing professionalism;
- Develop the sorting-recycling-recovery chain, with pilot sorting projects, to reach a recycling rate of 20% by 2022;
- Extend and implement solid waste management master plans for household waste and similar waste for all the prefectures and provinces of the Kingdom;
- Train and educate all stakeholders." (SWEEP-Net 2015, 17)

Essentially, the PNDM's objective is to be a tool for better waste management for the years to come, with a particular concern for provincial consistency. The Plan must make it possible to coordinate the actions carried out by both the public authorities and private organizations with the mission of achieving the objectives of Law No. 28-00 on waste management and disposal. In addition, Decree No. 2-09-285 of 23 Rejeb 1431 (July 6, 2010) set the terms for the preparation of the prefectural or provincial master plan for the management of household and similar waste and the procedure for organizing the initial surveying related to the PNDM.

National Reports and Studies on Solid Waste Management

In order to support these programs and projects, proper data must be collected to support these national programs and plans. In 2014, the German Society for International Cooperation (GIZ) published "National Report on Solid Waste" for Morocco with collaboration from the Directorate of Water and Sanitation, the Directorate General of Local Authorities, MOI, and MEMEE/DE in collaboration with an environmental consulting agency called planet-H20 and National SWEEP-Net Morocco.

The report outlined the legal and institutional framework, and current collection, treatment, and disposal methods of municipal and industrial wastes across different industries such as: medical, agricultural, hazardous, electronic, packaging, tires, construction, and fuels and lubricants. Within each industry it also assessed the extent of participation from the private sector, best practices, and upcoming initiatives.

Given the large scope of some industries, the report was unable to quantify the amount of tires, agricultural, and construction waste produced in Morocco. The report estimated that 6.852 million metric tonnes (T) of solid waste are produced each year. The industrial sector produced 1.6 million T, of which 289,368 T is hazardous waste. Each sectors' annual tonnage produced is listed in Table 1.

Table 1: National Solid Waste Produced Per Year

Industry	Tonnes/Year
Industrial	1.6 million
Hazardous	*289,385*
Medical	21,000
Electronic	30,300
Tires	55,000
Municipal	5.5 million
TOTAL	**7,206,300**

Source: GIZ, "Rapport sur la gestion de la déchets au Maroc", 2014, 7.

The amount of municipal solid waste estimated was 5.5 million tonnes a year. The composition of household solid waste was represented as 65% organic material, 10% paper and carton, 4% metals, 10% plastic, 3% glass, and 8% other (GIZ 2014, 7).

Alternatively, in a study performed by Enda Maghreb in 2008, they calculated the total amount of household solid waste at nearly 18,000 T a day, or around 6 million tonnes, with a composition of 60-80% organic matter, 7-10% paper, 1% metals, 4-7% plastic and rubber, 1.5% glass and ceramics, 7% wood, 3% fabric, .3% leather and skins, and 10.5% ash. (Soufi & Chrifi 2007/2008, 11-12)

The GIZ report estimated the daily ratio of waste generated for one person is 0.67 kilograms for urban areas and 0.3 kilograms for rural areas. Alternatively, the Enda Maghreb report calculated 1 kilogram for urban areas and 0.3 kilograms for rural areas. As a comparison, a study carried out by the Delegate Ministry for the Environment in 2004 estimated the waste production ratio by population sizes as shown in Table 2. (Hafidi 2015, 23)

Table 2: Solid Waste Production Per Person by Population Size

Industry	Tonnes/Year
Under 10,000	0.58
10,000 to 50,000	0.63
50,000 to 100,000	0.67
100,000 to 300,000	0.72
300,000 or More	0.81

Source: Hafidi, "L'impact et la gestion des déchets solides (Région Marrakech-Safi)", 2015, 23

Summary

Even though these programs and policies are still new, the success of them has ranked Morocco as the sixth climatically conscious country in the world, and number one in the developing world for 2020. This ranking is based on criteria set forth by GermanWatch's Climate Change Performance Index that includes CO_2 emissions, renewable energy development, efficiency, and climate policy (GermanWatch 2020). The policy being the impetus for driving development and innovation in the solid waste sector.

The most recent data produced to represent the solid waste sector can vary depending on the producer. However, it is important to understand this data is the most widely referenced in regional and provincial reports and note the context that it is used. The purpose of the national reports are to offer this reference point for local reports to begin building their data.

Al Haouz Province

The Al Haouz province was created by decree n °2-91-90 on September 25, 1991. The province is located within the Marrakech-Safi region and consists of about 12.7% of the region's population with 655,540 people as of 2020. According to the last administrative division in 2009, the province is divided into 40 municipalities, three of them are "pachaliks"; which are the head seats of the provincial administration (Tahannaout, Ait Ourir, and Amizmiz), including five administrative circles (Tahannaout, Ait Ourir, Amizmiz, Asni, and Touama) that consist of 37 rural municipalities (Figure 1 and Table 3).

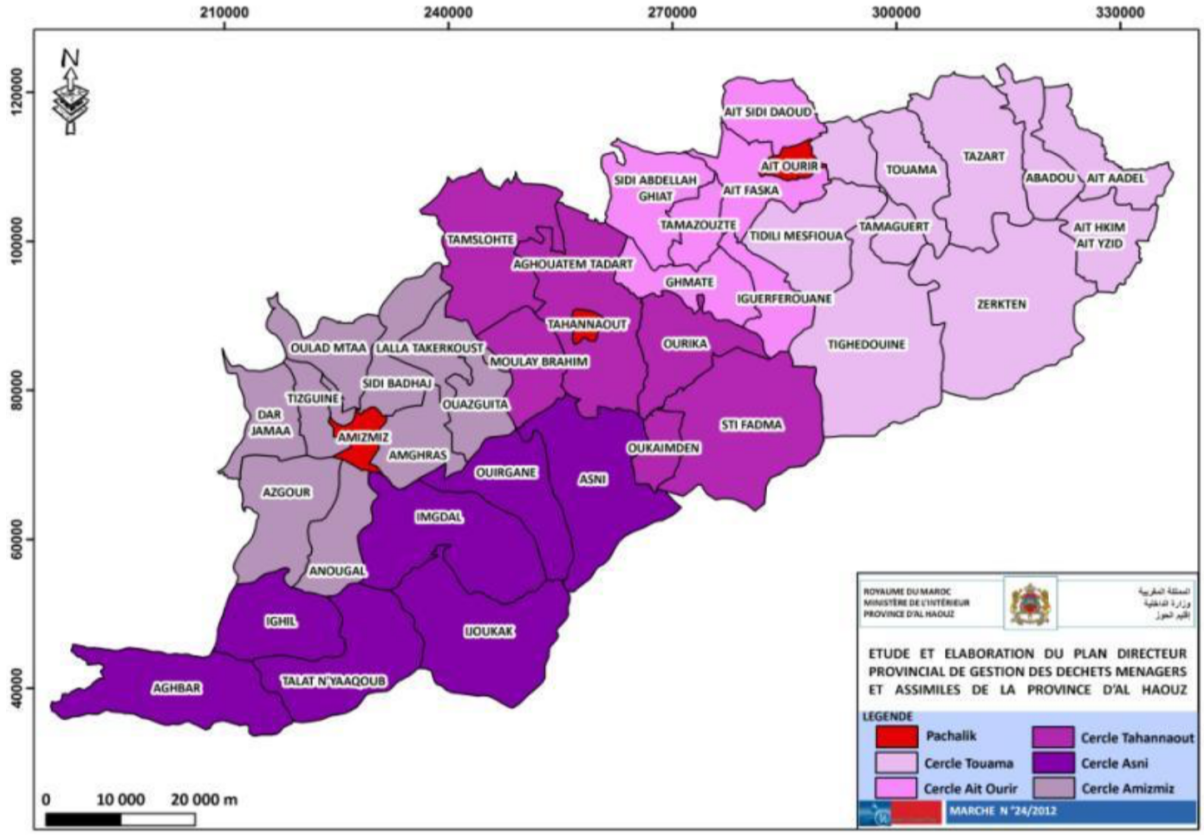


Figure 1: Map of the Administrative Organization of the Al Haouz Province.
Source: "Mission I: Plan Directeur Provincial de Gestion des Déchets Ménagers et Assimilés de la Province d'Al Haouz," Waman Management Consulting 2011, 19.

Table 3: List of the Administrative Organization of the Al Haouz Province

Circle/Pachaliks	Municipalities
TAHANNAOUT	TAMESLOUHTE
	MOULAY BRAHIM
	AGHOUATEM TADART
	OUKAÏMDEN
	OURIKA
	SETI FADMA
ASNI	ASNI
	OUIRGANE
	IMGDAL
	IJOUKAK
	TALAT'N YAAQOUB
	IGHIL
	AGHBAR
AMZIMIZ	AMAGHRAS
	DAR JAMAÂ
	OUZGUITA
	SIDI BADHAJ
	OULED MTAÂ
	TIZGUINE
	LALLA TAKERKOUST
	AZGOUR
	ANOUGAL
AÏT OURIR	AÏT FASKA
	AÏT SIDI DAOUD
	SIDI ABDELLAH GHIAT
	GHMATE
	TAMAZAZOUTE
	IGUERFEROUANE
TOUAMA	TOUAMA
	TAMAGUERT
	TIDILI MESFIOUA
	TIGHEDOUINE
	ZERKTEN

	TAZART
	AÏT ÂADEL
	ABADOU
	AÏT HKIM AÏT IZID

Source: Mission I: Plan Directeur Provincial de Gestion des Déchets Ménagers et Assimilés de la Province d'Al Haouz," Waman Management Consulting 2011, 17.

In previous years, the province of Al Haouz has faced rapid growth and urbanization like most of Morocco. From 2014 to 2020, the province saw an estimated 2.26% annual growth rate (AGR), expanding the population from 573,128 to 655,540. In comparison, the AGR from 2004 to 2014 was 1.70% according to the 2014 census (RGPH 2014). The estimated 2020 population for the entire Al Haouz province is listed in Table 4.

Table 4: Estimated Population and Annual Growth Rate (2020)

Municipality	Population 2014	Estimated Population 2020	'04-'14 AGR (%)	'14-'20 AGR (%)
AIT OURIR	39,108	55,369	6.93%	5.97%
TAHANNAOUT	14,364	14,769	0.47%	0.46%
AMIZMIZ	14,544	20,016	6.27%	5.47%
TAMESLOUHTE	28,978	34,316	3.07%	2.86%
MOULAY BRAHIM	11,813	12,330	0.73%	0.72%
AGHOUATEM TADART	30,776	49,057	-	8.08%
OUKAÏMDEN	4,861	5,126	0.91%	0.89%
OURIKA	37,316	44,682	3.29%	3.05%
SETI FADMA	24,129	25,287	0.80%	0.78%
ASNI	21,244	22,901	1.30%	1.26%
OUIRGANE	7,727	8,246	1.12%	1.09%
IMGDAL	5,467	5,424	-0.13%	-0.13%
IJOUKAK	6,700	6,736	0.09%	0.09%
TALAT'N YAAQOUB	7,866	7,965	0.21%	0.21%
IGHIL	5,695	5,739	0.13%	0.13%
AGHBAR	5,182	5,549	1.18%	1.15%
AMAGHRAS	6,160	7,583	3.85%	3.53%
DAR JAMAÂ	5,911	6,003	0.26%	0.26%

OUZGUITA	5,440	5,052	-1.19%	-1.23%
SIDI BADHAJ	5,394	4,776	-1.91%	-2.01%
OULED MTAÂ	6,937	7,869	2.24%	2.12%
TIZGUINE	4,899	5,587	2.34%	2.21%
LALLA TAKERKOUST	7,311	8,184	1.99%	1.90%
AZGOUR	6,865	7,211	0.84%	0.82%
ANOUGAL	4,353	4,463	0.42%	0.42%
AÏT FASKA	26,210	31,148	3.14%	2.92%
AIT SIDI DAOUD	18,976	18,794	-0.16%	-0.16%
SIDI ABDELLAH GHIAT	29,498	35,923	3.63%	3.34%
GHMATE	25,220	26,748	1.01%	0.99%
TAMAZOUZTE	15,846	18,327	2.61%	2.45%
IGUERFEROUANE	11,812	11,436	-0.53%	-0.54%
TOUAMA	11,243	11,115	-0.19%	-0.19%
TAMAGUERT	10,540	10,673	0.21%	0.21%
TIDILI MESFIOUA	21,706	22,071	0.28%	0.28%
TIGHEDOUINE	22,971	23,343	0.27%	0.27%
ZERKTEN	19,926	23,716	3.17%	2.95%
TAZART	15,243	13,176	-2.26%	-2.40%
AÏT ÂADEL	7,925	8,543	1.30%	1.26%
ABADOU	10,602	11,035	0.68%	0.67%
AIT IZID AIT HKIM	8,812	9,251	0.83%	0.81%
AL HAOUZ PROVINCE TOTAL	**573,128**	**655,540**	**1.70%**	**2.26%**

Even though there are still four years remaining until the next census, the 2020 estimates were extrapolated using the following equation shown below.

$$Pop_{Future} = Pop_{Present} x(1+i)^n$$

Where:
PopPresent = Present Population
i = Annual Growth Rate
n = Number of Years

The 2014 AGRs of each municipality in the Al Haouz province were used in the equation, keeping a linear rate of growth. This produced the 2020 population for each municipality and therefore, the Al Haouz province (Table 4). The below equation was then applied to estimate the overall growth rate for 2014 to 2020.

$$PR = \frac{(V_{Present} - V_{Past})}{V_{Past}} x\,100$$

Where:
PR = Percent Rate
$V_{Present}$ = Present or Future Population
V_{Past} = Past or Present Population

Unfortunately, this population increase is not always accompanied by the availability of services for effective solid waste management of household and similar waste, which constitutes a serious threat to the environment. One of the objectives of the PNDM concerns the development of master plans for the management of household waste for all the prefectures and provinces of the kingdom. However, given the longevity of waste management infrastructure (such as landfills, transfer stations, etc.), there is a need for longer term planning.

Al Haouz Province Master Plan for Household Solid Waste

Law 28-00 stipulates that a provincial master plan is established for a period of 10 years, but can be revised whenever the circumstances require it according to the same procedure followed for its preparation. A solid waste provincial master plan report was developed in three phases in 2011, 2015, and 2019 by Waman Management Consulting and the Regional Directorate of Environment for the Marrakech-Safi region. Implementation of the third mission is still in its early stages.

The three missions drafted to establish the master plan are as follows:

> ● "Mission 1: Characterization of the current situation, development of collection, treatment, recycling and landfill objectives for the provincial plan for the management of household and similar waste and evaluation of the social, environmental, economic and financial impacts of the objectives selected;
> ● Mission 2: Choice of sites for landfill, treatment, recycling, transfer and the provincial operational scenario for the objectives selected;
> ● Mission 3: is a synthesis of the two previous missions, written in the form of a proposal for a provincial master plan for the management of household and similar waste, in accordance with Law 28-00 on waste management and its disposal, as well as its implementing decrees and other regulatory texts applicable to waste management." (Waman Management Consulting 2015, 6)

The master plan is based on the objectives of improving the environment and the quality of life for citizens by improving and optimizing collection and cleaning services when they exist, the creation of these services in municipalities that do not have them, the development of intermunicipal cooperation, and sustainable disposal methods for waste disposal.

Research Findings

Waman Management Consulting generated optimal data collection consisting of population projections and solid waste tonnage production in five-year intervals until 2035. They also performed many community meetings to determine the best location for each of the four proposed waste transfer stations. These site selections are also given a comprehensive cost assessment for construction and operation costs.

Data was chosen from the reports to offer a baseline for me to manipulate in order to best answer the following questions:

3. What is the current population of the Al Haouz province and all the municipalities?
4. How much household solid waste is produced in the Al Haouz province in 2020?
5. What is the composition of the solid waste produced in the province?

The plans provided the necessary data to adequately address these questions and more, while also putting the data in context of the final end-goal of establishing waste transfer stations in the province.

Total Household Solid Waste Generated

The report gathered data for daily and annual tonnage collected from both controlled landfills and/or illegal dumping sites in the Al Haouz province. The waste typology taken into account is: household waste, inert waste, large waste, garden waste, and waste from economic activities which can be assimilated to household waste.

However, in sites where there is only illegal dumping, the data can be skewed because the trash is often burned away to make way for more trash. Since few municipalities have improved their collection methods since 2015, such as Tameslouhte; as well as the addition of the Aghouatem Tadart rural municipality in 2009[1], some of the reports' calculations are no longer up to date.

In order to update and extrapolate this base data to establish a more confident calculation of solid waste tonnage produced, I added the 2020 population estimates and multiplied them by the production ratios established by the Ministry of Environment's 2004 solid waste study listed in Table 2. This equation was applied to all municipalities in the Al Haouz province to calculate the daily and yearly tonnage of household solid waste (HSW) produced shown in Tables 5 and 6.

Table 5: Daily HSW Produced in the Al Haouz Province

MUNICIPALITY	2014 HSW Production (T/day)	Estimated 2020 HSW Production (T/day)
TAHANNAOUT	9,049	9,304
TAMESLOUHTE	18,256	21,556
AGHOUATEM TADART	19,389	30,906
OUKAÏMDEN	2,819	2,973
OURIKA	23,509	28,150
SETI FADMA	15,201	15,931

[1] The administration division established Aghouatim Tadart as its own rural municipality in 2009. This area formerly belonged to the Tahannaout commune, therefore making Tahannaout its own urban municipality. This is why the population for Tahannaout decreased from 29,562 in 2004 to 14,364 in 2014.

AIT OURIR	26,202	37,097
AÏT FASKA	16,512	19,623
AIT SIDI DAOUD	11,955	11,840
SIDI ABDELLAH GHIAT	18,584	22,631
GHMATE	15,889	16,851
TAMAZOUZTE	9,983	11,546
IGUERFEROUANE	7,442	7,205
TOUAMA	7,083	7,002
TAMAGUERT	6,640	6,724
TIDILI MESFIOUA	6,679	13,905
TIGHEDOUINE	14,472	14,706
ZERKTEN	12,553	14,941
TAZART	9,603	8,301
AÏT ÂADEL	4,597	4,955
ABADOU	6,996	6,952
AMIZMIZ	9,163	12,610
AMAGHRAS	3,573	4,398
DAR JAMAÂ	3,428	3,482
OUZGUITA	3,155	2,930
SIDI BADHAJ	3,129	2,770
OULED MTAÂ	4,023	4,564
TIZGUINE	2,841	3,240
LALLA TAKERKOUST	4,240	4,747
ASNI	13,384	14,428
MOULAY BRAHIM	7,442	7,768
OUIRGANE	4,482	4,783
IMGDAL	3,171	3,146
IJOUKAK	3,886	3,907
TALAT'N YAAQOUB	4,562	4,620

IGHIL	3,303	3,329
AGHBAR	3,006	3,218
AZGOUR	3,982	4,182
ANOUGAL	2,525	2,588
AIT IZID AIT HKIM	5,111	5,365
TOTAL	**351,820**	**409,176**

The updated data produced estimated a 16.3% increase of daily waste produced from 351,820 T in 2014 to 409,176 T in 2020. In terms of yearly production, the province produced 128,414,143 T of HSW in 2014 and 149,349,302 T in 2020. This rapidly increasing level of production is still not being met with proper waste management infrastructure. Some municipalities have improved their collection methods with trucks instead of donkey pulled carts, but the disposal methods are still inadequate. The master plan addressed this issue by recommending the establishment of four solid waste transfer stations in each designated quadrant. The purpose of these stations are to gather the waste from all the municipalities in their quadrant and then send the waste to be landfilled and treated at the CEV facility in Marrakech.

Table 6: Yearly HSW Produced in the Al Haouz Province

MUNICIPALITIES	2014 HSW Production (T/yr)	Estimated 2020 HSW Production (T/yr)
TAHANNAOUT	3,303,002	3,396,132
TAMESLOUHTE	6,663,491	7,867,969
AGHOUATEM TADART	7,076,941	11,280,657
OUKAÏMDEN	1,029,074	1,085,174
OURIKA	8,580,814	10,274,626
SETI FADMA	5,548,464	5,814,746
AIT OURIR	9,563,861	13,540,489
AÏT FASKA	6,026,990	7,162,483

AIT SIDI DAOUD	4,363,531	4,321,641
SIDI ABDELLAH GHIAT	6,783,065	8,260,494
GHMATE	5,799,339	6,150,703
TAMAZOUZTE	3,643,788	4,214,294
IGUERFEROUANE	2,716,169	2,629,708
TOUAMA	2,585,328	2,555,894
TAMAGUERT	2,423,673	2,454,211
TIDILI MESFIOUA	2,437,930	5,075,226
TIGHEDOUINE	5,282,181	5,367,723
ZERKTEN	4,581,984	5,453,494
TAZART	3,505,128	3,029,833
AÏT ÂADEL	1,677,723	1,808,585
ABADOU	2,553,595	2,537,498
AMIZMIZ	3,344,404	4,602,679
AMAGHRAS	1,304,072	1,605,313
DAR JAMAÂ	1,251,359	1,270,880
OUZGUITA	1,151,648	1,069,420
SIDI BADHAJ	1,141,910	1,011,047
OULED MTAÂ	1,468,563	1,665,938
TIZGUINE	1,037,118	1,182,730
LALLA TAKERKOUST	1,547,739	1,732,553
ASNI	4,885,058	5,266,085
MOULAY BRAHIM	2,716,399	2,835,284
OUIRGANE	1,635,806	1,745,732
IMGDAL	1,157,364	1,148,366
IJOUKAK	1,418,390	1,426,049
TALAT'N YAAQOUB	1,665,232	1,686,191
IGHIL	1,205,632	1,215,035
AGHBAR	1,097,029	1,174,699

AZGOUR	1,453,321	1,526,568
ANOUGAL	921,530	944,753
AIT IZID AIT HKIM	1,865,500	1,958,402
TOTAL	**128,414,143**	**149,349,302**

The provincial master plan addressed this issue by recommending the establishment of four solid waste transfer stations in each designated quadrant. The purpose of these stations are to gather the waste from all the municipalities in their quadrant and then send the waste to be landfilled and treated at the Marrakech landfill and recovery center (CEV).

Solid Waste Transfer Stations

The master plan outlined the location and justification of four transfer stations with groupings in the Center, South, East, and West quadrants of the province. The proposed transfer sites were chosen based on their centralized location in relation to the other municipalities within their quadrant, and the cost-benefit analysis of the amount of tonnage hauled and transportation costs of the distance travelled between the transfer station and the CEV (Table 7). The report recommends that independent recycling stations and compost operations be established in each of the rural municipalities clustered in the "mountainous group". The reason being because they are located too far from any proposed transfer station.

Table 7 shows the amount of household waste produced by each municipality in the Al Haouz province for 2020 and the projected amount of waste that will be produced in 2040. The reason for the 20-year horizon is because that is the typical lifespan of a landfill facility before improvements will need to be made. The current stations' design capacity is to handle the amount of waste projected in this 20-year timeframe, which is susceptible to change due to several socio-economic factors that are unforeseen.

Table 7: Transfer Station Quadrants and Tonnage Produced (2020 & 2040)

QUADRANT	MUNICIPALITY	Tonnage (t/yr) in 2020	Tonnage (t/yr) in 2040	Distance in Km from Municipality Center to Transfer Station
CENTRAL TRANSFER STATION: OULAD MONSOUR - AGHOUATIM TADART (86km from CEV Marrakech)	TAHANNAOUT	3,396,132	3,702,046	13.5
	TAMESLOUHTE	7,867,969	12,353,279	18
	AGHOUATEM TADART	11,280,657	23,342,071	5
	OUKAÏMDEN	1,085,174	1,267,239	69
	OURIKA	10,274,626	16,359,147	29
	SETI FADMA	5,814,746	6,680,344	54.5
	TOTAL	**39,719,304**	**63,704,127**	
EASTERN TRANSFER STATION: EL KHETARA - AÏT OURIR (86km from CEV)	AÏT OURIR	13,540,489	24,402,264	1.5
	AÏT FASKA	7,162,483	10,601,378	7
	AIT SIDI DAOUD	4,321,641	4,181,242	13.8
	SIDI ABDELLAH GHIAT	8,260,494	13,476,831	24
	GHMATE	6,150,703	7,285,456	28
	TAMAZOUZTE	4,214,294	5,969,501	16.7
	IGUERFEROUANE	2,629,708	2,336,748	19.6
	TOUAMA	2,555,894	2,456,976	20
	TAMAGUERT	2,454,211	2,555,342	26.2
	TIDILI MESFIOUA	5,075,226	5,352,215	18
	TIGHEDOUINE	5,367,723	5,650,586	27
	ZERKTEN	5,453,494	8,090,574	42.8
	TAZART	3,029,833	1,213,431	32
	AÏT ÂADEL	1,808,585	2,419,315	53.7
	ABADOU	2,537,498	2,861,891	56.9
	TOTAL	**74,562,276**	**98,853,751**	
WESTERN TRANSFER STATION: AZNAG - AMZIMIZ (104km from CEV)	AMIZMIZ	4,602,679	8,098,554	3
	AMAGHRAS	1,605,313	2,714,775	11.6
	DAR JAMAÂ	1,270,880	1,335,423	17.5
	OUZGUITA	1,069,420	784,167	40.9
	SIDI BADHAJ	1,011,047	545,576	12

	OULED MTAÂ	1,665,938	2,476,243	8
	TIZGUINE	1,182,730	1,634,192	11
	LALLA TAKERKOUST	1,732,553	2,510,805	19
	TOTAL	**14,140,559**	**20,099,735**	
SOUTHERN TRANSFER STATION: ALHIANE - ASNI (103km from CEV)	ASNI	5,266,085	6,485,292	3
	MOULAY BRAHIM	2,835,284	3,222,909	9.5
	OUIRGANE	1,745,732	2,099,431	13.5
	IMGDAL	1,148,366	1,118,237	37
	IJOUKAK	1,426,049	1,451,513	44.4
	TALAT'N YAAQOUB	1,686,191	1,755,698	47
	TOTAL	**14,107,706**	**16,133,079**	
MOUNTAINOUS GROUP: RECOMMENDED TO ESTABLISH INDEPENDENT RECYCLING TERMINALS AND COMPOST CENTERS	IGHIL	1,215,035	1,246,258	
	AGHBAR	1,174,699	1,424,144	
	AZGOUR	1,526,568	1,764,321	
	ANOUGAL	944,753	1,021,141	
	AÏT IZID AÏT HKIM	1,958,402	2,454,878	
	TOTAL	**6,819,457**	**7,910,742**	
AL HAOUZ TOTAL		**149,349,302**	**206,701,434**	

The original data presented in the Mission II report contained the projected tonnage for 3035 based on the estimates for 2015. It also listed the distance of each municipality in relation to the CEV, they were changed to show the relation between the municipality centers and the proposed transfer station. A map of the transfer stations' locations are shown in figure 2. The data was updated using the population and HSW tonnage extrapolation methods mentioned earlier to estimate the 2040 data.

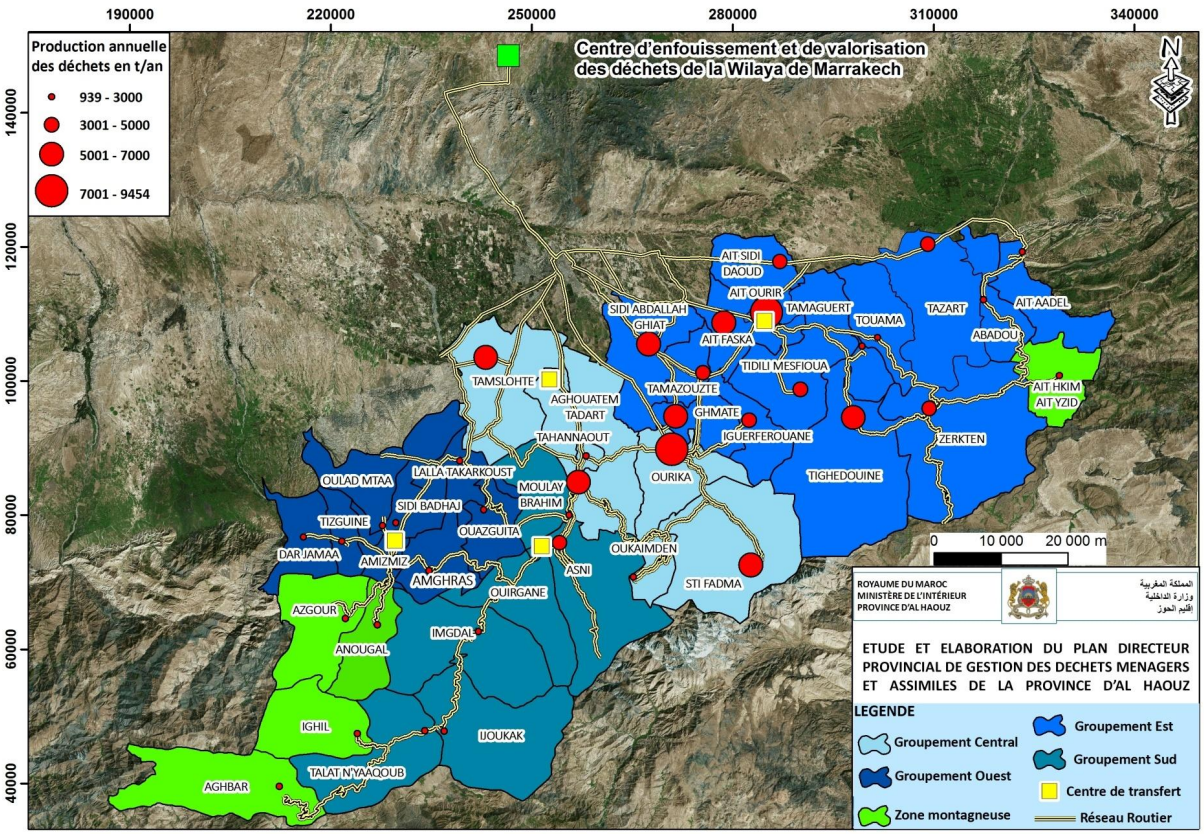


Figure 2: Map of the location of the transfer stations, their quadrants served, and the annual household solid waste production in 2014 for each municipality.
Source: Mission II: Plan Directeur Provincial de Gestion des Déchets Ménagers et Assimilés de la Province d'Al Haouz Waman Consulting 2015, 119.

The amount of anticipated daily and yearly HSW produced in the Al Haouz province for 2040 are 565,495 T and 206,701,434 T. This estimated 20-year increase in waste production is an estimated 38.4% from 2020 tonnage. The total tonnage produced in each quadrant is represented in Table 8.

Table 8: Total Tonnage Produced by Each Quadrant (2020 & 2040)

QUADRANT	DAILY AMOUNT OF WASTE IN TONNES (2040)	YEARLY AMOUNT OF WASTE IN TONNES (2040)	% OF WASTE IN THE PROVINCE
CENTRAL	174,532	63,704,127	30.8%
EAST	270,832	98,853,751	47.8%
WEST	55,068	20,099,735	9.7%
SOUTH	44,200	16,133,079	7.8%

MOUNTAINOUS	20,863	7,910,742	3.8%
TOTAL	**565,495**	**206,701,434**	**100%**

Solid Waste Composition

Many reports provide base percentages to represent the composition of solid waste but rarely provide tonnage estimates. It is not practical to apply national composition percentages to a particular area due to the various economic activities of each region and province. The Al Haouz province study established baseline composition percentages by analyzing solid waste in Ait Ourir (urban) and Talat'N Yacoub (rural) (Table 9). Even these numbers are specific to these areas, since Al Haouz is a very geographically diverse province.

Table 9: Solid Waste Composition in Morocco and the Al Haouz Province

Solid Waste Composition	Morocco Composition	Average Urban Composition (Ait Ourir)	Average Rural Composition (Talat'N Yacoub)	Average Composition (Urban and Rural)
Organic Material	60-80%	71.3%	83.3%	77.3%
Paper and Carton	7-10%	5.2%	6.1%	5.65%
Plastic	4-7%	6.1%	5.7%	5.9%
Metal	1%	1.1%	1.2%	1.15%
Glass and Ceramic	1.5%	2.2%	1.6%	1.9%
Wood	7%	1.2%	0.7%	0.95%
Other (Ash, Fabric, Leather and Skins)	11.1%	12.9%	1.4%	7.15%

Source: Mission I: Plan Directeur Provincial de Gestion des Déchets Ménagers et Assimilés de la Province d'Al Haouz Waman Consulting 2011, 111.

In order to estimate the tonnage of each material generated across the Al Haouz province, an average percentage was established for HSW composition and then applied to the overall tonnage calculated in Tables 5 and 6. The tables below represent the overall HSW composition estimated daily and yearly tonnage in each municipality in the Al Haouz province, and the total tonnage per material for 2020.

Table 10: Daily Solid Waste Composition in the Al Haouz Province (2020) (T/day)

QUADRANTS	MUNICIPALITY	ORGANIC MATERIAL	PAPER & CARTON	PLASTIC	METAL	GLASS & CERAMIC	WOOD	OTHER	TOTAL
CENTRAL	TAHANNAOUT	7,192	526	549	107	177	884	665	**10,099**
	TAMESLOUHTE	16,663	1,218	1,272	248	410	2,048	1,541	**23,399**
	AGHOUATEM TADART	23,890	1,746	1,823	355	587	2,936	2,210	**33,548**
	OUKAÏMDEN	2,298	168	175	34	56	282	213	**3,227**
	OURIKA	21,760	1,590	1,661	324	535	2,674	2,013	**30,557**
	SETI FADMA	12,315	900	940	183	303	1,513	1,139	**17,293**
EAST	AIT OURIR	28,676	2,096	2,189	4,266	705	3,524	2,652	**44,108**
	AÏT FASKA	15,169	1,109	1,158	226	373	1,864	1,403	**21,301**
	AIT SIDI DAOUD	9,152	669	699	136	225	1,125	847	**12,852**
	SIDI ABDELLAH GHIAT	17,494	1,279	1,335	260	430	2,150	1,618	**24,566**
	GHMATE	13,026	952	994	194	320	1,601	1,205	**18,292**
	TAMAZOUZTE	8,925	652	681	133	219	1,097	826	**12,533**
	IGUERFEROUANE	5,569	407	425	83	137	684	515	**7,821**
	TOUAMA	5,413	396	413	81	133	665	501	**7,601**
	TAMAGUERT	5,198	380	397	77	128	639	481	**7,299**
	TIDILI MESFIOUA	10,749	786	820	160	264	1,321	994	**15,094**
	TIGHEDOUINE	11,368	831	868	169	279	1,397	1,051	**15,963**
	ZERKTEN	11,549	844	882	172	284	1,419	1,068	**16,218**
	TAZART	6,417	469	490	95	158	789	594	**9,011**
	AÏT ÂADEL	3,830	280	292	57	94	471	354	**5,379**
	ABADOU	5,374	393	410	80	132	660	497	**7,546**
WEST	AMIZMIZ	9,748	712	744	145	240	1,198	902	**13,688**
	AMAGHRAS	3,400	248	259	51	84	418	314	**4,774**
	DAR JAMAÂ	2,691	197	205	40	66	331	249	**3,780**
	OUZGUITA	2,265	166	173	34	56	278	209	**3,180**
	SIDI BADHAJ	2,141	157	163	32	53	263	198	**3,007**
	OULED MTAÂ	3,528	258	269	52	87	434	326	**4,954**
	TIZGUINE	2,505	183	191	37	62	308	232	**3,517**
	LALLA TAKERKOUST	3,669	268	280	55	90	451	339	**5,153**

SOUTH	ASNI	11,153	815	851	166	274	1,371	1,032	**15,662**
	MOULAY BRAHIM	6,005	439	458	89	148	738	555	**8,432**
	OUIRGANE	3,697	270	282	55	91	454	342	**5,192**
	IMGDAL	2,432	178	186	36	60	299	225	**3,415**
	IJOUKAK	3,020	221	231	45	74	371	3,907	**7,869**
	TALAT'N YAAQOUB	3,571	261	273	53	88	439	330	**5,015**
MOUNTAINOUS GROUP	IGHIL	2,573	188	196	38	63	316	238	**3,613**
	AGHBAR	2,488	182	190	37	61	306	230	**3,494**
	AZGOUR	3,233	236	247	48	79	397	299	**4,540**
	ANOUGAL	2,001	146	153	30	49	246	185	**2,810**
	AIT IZID AIT HKIM	4,148	303	317	62	102	510	384	**5,824**
TOTAL		**182,129**	**13,312**	**13,901**	**6,549**	**4,477**	**22,383**	**16,846**	**259,597**

Table 11: Yearly Solid Waste Composition in the Al Haouz Province (2020) (T/yr)

QUADRANTS	MUNICIPALITY	ORGANIC MATERIAL	PAPER & CARTON	PLASTIC	METAL	GLASS & CERAMIC	WOOD	OTHER	TOTAL
CENTRAL	TAHANNAOUT	2,625,077	191,872	200,362	39,054	64,523	322,616	242,811	**3,686,315**
	TAMESLOUHTE	6,081,918	444,539	464,208	90,481	149,491	747,454	562,558	**8,540,649**
	AGHOUATEM TADART	8,719,973	637,359	665,561	129,728	214,333	1,071,666	806,569	**12,245,189**
	OUKAÏMDEN	838,840	61,312	64,025	12,480	20,618	103,092	77,590	**1,177,957**
	OURIKA	7,942,382	580,523	606,210	118,160	195,220	976,101	734,645	**11,153,241**
	SETI FADMA	4,494,852	328,537	343,074	66,870	110,481	552,407	415,759	**6,311,982**
EAST	AIT OURIR	10,466,733	765,033	798,884	1,557,172	257,268	1,286,338	968,139	**16,099,567**
	AÏT FASKA	5,536,531	404,675	422,581	82,368	136,086	680,428	512,111	**7,774,780**
	AIT SIDI DAOUD	3,340,628	244,173	254,977	49,699	82,111	410,556	308,997	**4,691,140**
	SIDI ABDELLAH GHIAT	6,385,223	466,708	487,359	94,994	156,946	784,730	590,613	**8,966,572**
	GHMATE	4,754,425	347,510	362,886	70,732	116,862	584,308	439,769	**6,676,493**
	TAMAZOUZTE	3,257,649	238,108	248,643	48,464	80,072	400,358	301,322	**4,574,616**
	IGUERFEROUANE	2,032,764	148,579	155,153	30,242	49,964	249,822	188,024	**2,854,548**
	TOUAMA	1,975,706	144,408	150,798	29,393	48,562	242,810	182,746	**2,774,423**
	TAMAGUERT	1,897,105	138,663	144,798	28,223	46,630	233,150	175,476	**2,664,046**

	TIDILI MESFIOUA	3,923,226	286,756	299,444	58,366	96,431	482,156	362,886	**5,509,265**
	TIGHEDOUINE	4,149,224	303,274	316,694	61,728	101,986	509,931	383,790	**5,826,627**
	ZERKTEN	4,215,528	308,121	321,754	62,715	103,616	518,079	389,923	**5,919,736**
	TAZART	2,342,061	171,186	178,760	34,843	57,567	287,834	216,633	**3,288,883**
	AÏT ÂADEL	1,398,036	102,185	106,707	20,799	34,363	171,816	129,314	**1,963,219**
	ABADOU	1,961,486	143,369	149,712	29,181	48,212	241,062	181,431	**2,754,454**
WEST	AMIZMIZ	3,557,848	260,050	271,556	52,930	87,450	437,252	329,089	**4,996,177**
	AMAGHRAS	1,240,907	90,700	94,713	18,461	30,501	152,505	114,780	**1,742,567**
	DAR JAMAÂ	982,390	71,805	74,982	14,615	24,147	120,734	90,868	**1,379,540**
	OUZGUITA	826,662	60,422	63,096	12,298	20,319	101,595	76,464	**1,160,856**
	SIDI BADHAJ	781,539	57,124	59,652	11,627	19,210	96,049	72,290	**1,097,491**
	OULED MTAÂ	1,287,770	94,125	98,290	19,158	31,653	158,264	119,115	**1,808,375**
	TIZGUINE	914,250	66,824	69,781	13,601	22,472	112,359	84,565	**1,283,853**
	LALLA TAKERKOUST	1,339,263	97,889	102,221	19,924	32,919	164,593	123,878	**1,880,686**
SOUTH	ASNI	4,070,788	297,541	310,707	60,562	100,058	500,291	376,535	**5,716,482**
	MOULAY BRAHIM	2,191,674	160,194	167,282	32,606	53,870	269,352	202,723	**3,077,700**
	OUIRGANE	1,349,451	98,634	102,998	20,076	33,169	165,845	124,820	**1,894,992**
	IMGDAL	887,687	64,883	67,754	13,206	21,819	109,095	82,108	**1,246,551**
	IJOUKAK	1,102,336	80,572	84,137	16,400	27,095	135,475	101,963	**1,547,977**
	TALAT'N YAAQOUB	1,303,425	95,270	99,485	19,391	32,038	160,188	120,563	**1,830,360**
MOUNTAINOUS GROUP	IGHIL	939,222	68,650	71,687	13,973	23,086	115,428	86,875	**1,318,921**
	AGHBAR	908,042	66,370	69,307	13,509	22,319	111,596	83,991	**1,275,136**
	AZGOUR	1,180,037	86,251	90,068	17,556	29,005	145,024	109,150	**1,657,089**
	ANOUGAL	730,294	53,379	55,740	10,865	17,950	89,752	67,550	**1,025,529**
	AIT IZID AIT HKIM	1,513,845	110,650	115,546	22,522	37,210	186,048	140,026	**2,125,846**
TOTAL		**66,476,996**	**4,858,927**	**5,073,923**	**2,390,442**	**1,633,975**	**8,169,877**	**6,148,907**	**94,753,047**

The daily and yearly composition of HSW in the province was estimated at 182,129 T/day and 66,476,996 T/yr for organic material, 13,312 T/yr and 4,858,927 T/yr for paper and carton, 13,901 T/day and 5,073,923 T/yr for plastic, 6,549 T/day and 2,390,442 T/yr for metal, 4,477

T/day and 1,633,975 T/yr for glass and ceramic, 22,383 T/day and 8,169,877 T/yr for wood, and 16,846 T/day and 6,148,907 T/yr for other wastes.

The data calculated gives us a better understanding of the amount of what types of HSW is produced in the province to better plan for how to recycle and "upcycle" materials *beyond* simple landfilling. This creates an opportunity for establishing recycling centers or composting operations in areas to help benefit the surrounding communities with economic, social, and environmental development.

Conclusion

The research and analysis detailed in the Al Haouz household solid waste master plan provided a superb benchmark to manipulate in order to estimate the amount of HSW generated and its composition. The importance of this data is to support future proposals by providing a new benchmark for HSW data in the Al Haouz province.

The data produced could benefit future project proposals in response to the current master plan. Hopefully encouraging local governments, associations, and businesses to create their own plans or start-ups that can directly recover and reuse the solid waste that is already being gathered by the proposed transfer stations.

This is a more sustainable method than sending the HSW of an entire province to the Marrakech CEV, that is already taking in the solid waste from their own province. This solution recommended by the current master plan is not viable in the long-term, since it will only shorten the lifespan of the CEV by reaching its capacity quicker.

Appendices: Surveys Distributed

Surveys were distributed by the researcher, local associations, in the area. The main waste streams that were recorded reflected average household waste and restaurant waste, such as cardboard and carton, and plastic. Given the time constraints of the research period and the difficulty with measurements, the researcher decided to not include food waste. It was noted that most food waste in smaller communities are eaten by animals. The main purpose of the research was to determine the quantity of particular materials based on their versatility to be recycled and reused in ways that could benefit the community economically.

Appendix A: Context Survey

The initial survey distributed asked the size of the household, the size of their trash cans, how often they emptied their bins per week, what was the overall composition of their waste, and what were their perceptions on waste management in their communities and if they had advice on improving their conditions. This data was asked to provide a basic benchmark to the average Moroccan households in each area.



إستمارة النفايات الصلبة المنزلية

الغرض من هذا المسح هو فهم أفضل لتركيبة النفايات المنزلية. السبب في أهمية هذه البيانات هو أنها ستتيح لمجتمعك خطة أفضل للنمو المستقبلي. كما ستساعد الجمعيات والحكومات المحلية على قياس أنواع النفايات الصلبة التي يتم إنتاجها بشكل أفضل وسيتم استخدام هذه البيانات في المشاريع المستقبلية التي ستجعل مجتمعك أكثر صحة للأجيال القادمة. شكرا!

هل تعتقد أن القمامة قضية رئيسية في محيطك وفي المغرب؟

☐نعم ☐لا ☐ممكن

إذا كانت الإجابة نعم ، فكيف سيكون الحل لحل هذا؟

هل تضع كيس بلاستيكي داخل صندوق القمامة؟

☐نعم ☐لا

كم يتواجد من شخص في اسرتك؟

ما هو حجم القمامة في اللتر؟

إذا كانت الإجابة نعم ، فهل تملئ الكيس تمامًا بداخل صندوق القمامة؟

☐نعم ☐لا ☐احيانا

إذا لم يكن لديك صندوق قمامة ، فهل تستخدم فقط الاكياس البلاستيكية ؟

☐نعم ☐لا

كم مرة تستخدمين الأكياس البلاستيكية مقارنةً بالأكياس القماشية الحديثة؟

☐100% بلاستيك / 0% ثوبمرتين ☐75% بلاستيك / 25% ثوب

☐50% بلاستيك / 50% ثوب ☐25% بلاستيك / 75% ثوب

☐0% بلاستيك / 100% ثوب

كم مرة في اليوم تقوم بتفريغ صندوق القمامة الخاص بك أو التخلص من اكياس القمامة؟

☐0-1 مرة في اليوم ☐مرتين ☐ثلاث مرات ☐اربع مرات ☐اكثر

ما هي أنواع النفايات التي تتخلص منها في صندوق القمامة؟ قد تشمل أنواع النفايات البلاستيك وفضلات الطعام واللحوم والخضروات والزجاج والمعادن.

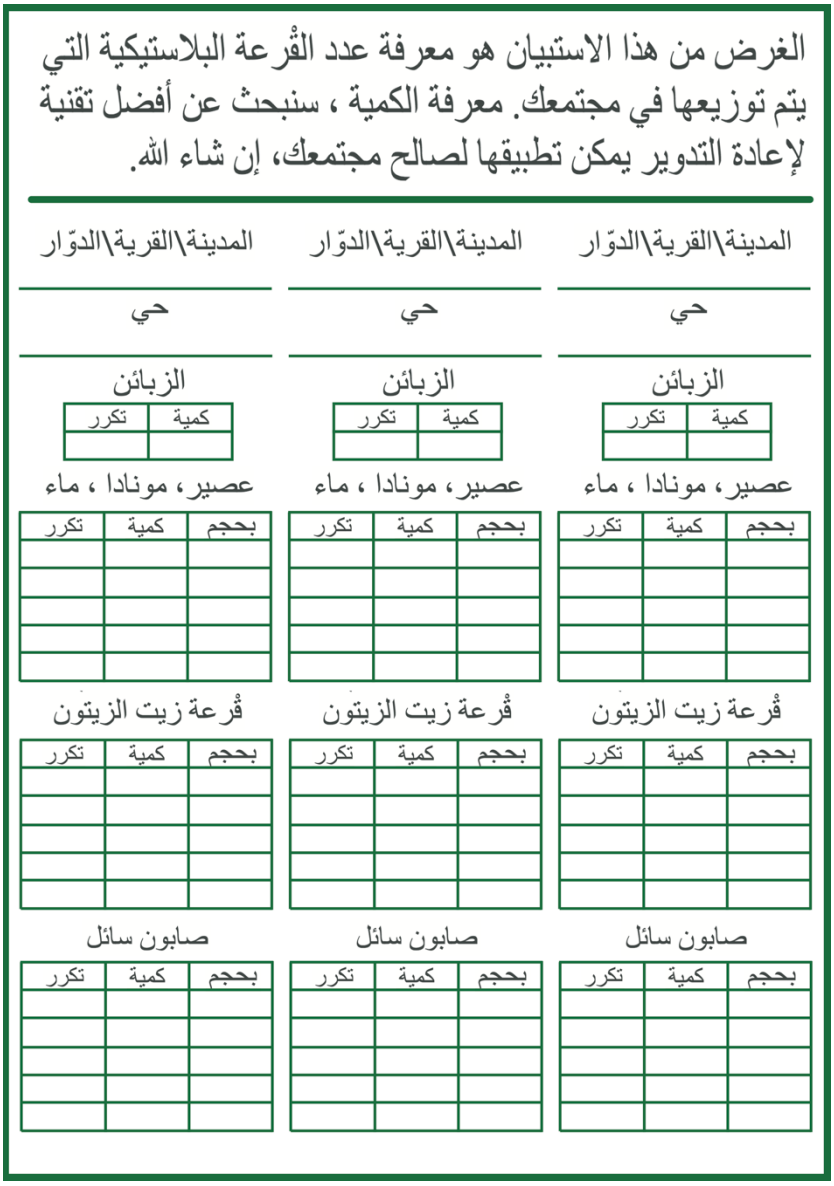
هل تدفعون النقود لجامع القمامة أم تقومون برميها في "مكب نفايات" قريب؟

☐دفع النقود ☐مكب النفايات ☐آخر

أي اقتراحات أو تعليقات أخرى؟

Appendix B: Plastic Bottle Survey

The plastic bottle surveys analyzed the amount of bottles sold by corner stores, amount of bottles thrown out by households and restaurants/cafes, and the amount of bottles gathered by the waste management services and put in the local landfill. Sizes were classified by the different types of plastic bottles (water/soda/juice, olive oil, or cleaning supplies) and their volume (500ml, 1L, 1.5L, 2L, 5L). The data point was noted and the averages were made for each location independently.



الغرض من هذا الاستبيان هو معرفة عدد القُرعة البلاستيكية التي يتم توزيعها في مجتمعك. معرفة الكمية ، سنبحث عن أفضل تقنية لإعادة التدوير يمكن تطبيقها لصالح مجتمعك، إن شاء الله.

المدينة\القرية\الدوّار

حي

الزبائن

كمية	تكرر

عصير، مونادا ، ماء

بحجم	كمية	تكرر

قُرعة زيت الزيتون

بحجم	كمية	تكرر

صابون سائل

بحجم	كمية	تكرر

المدينة\القرية\الدوّار

حي

الزبائن

كمية	تكرر

عصير، مونادا ، ماء

بحجم	كمية	تكرر

قُرعة زيت الزيتون

بحجم	كمية	تكرر

صابون سائل

بحجم	كمية	تكرر

المدينة\القرية\الدوّار

حي

الزبائن

كمية	تكرر

عصير، مونادا ، ماء

بحجم	كمية	تكرر

قُرعة زيت الزيتون

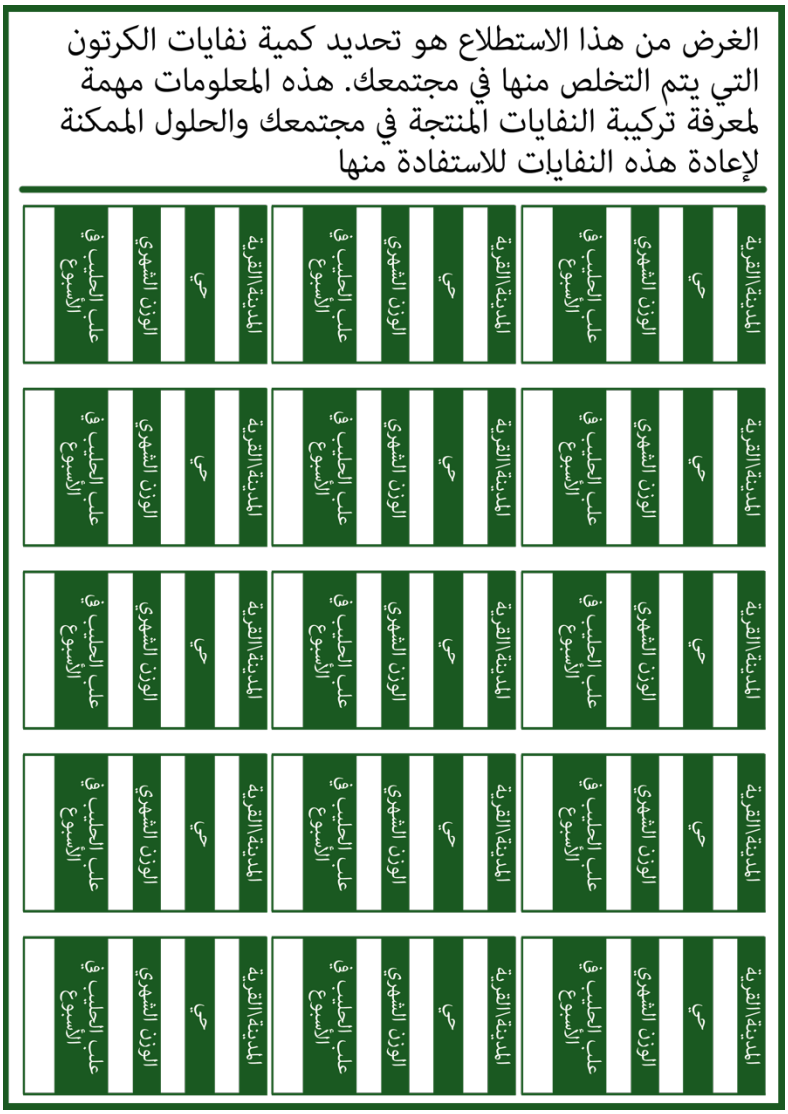
بحجم	كمية	تكرر

صابون سائل

بحجم	كمية	تكرر

Appendix C: Cardboard and Carton Survey

The cardboard and carton waste was measured mainly from the restaurants, cafes, and corner stores since they order goods in bulk. We measured the frequency and amount of cardboard boxes they receive and discard. Households and corner stores were asked how many cartons of milk and other cardboard packaging were sold and discarded. The data point was noted and the averages were made for each location independently.



Works Cited

Conference of the Parties (COP) | UNFCCC. (2019, June 12). Retrieved from Unfccc.int website: https://unfccc.int/process/bodies/supreme-bodies/conference-of-the-parties-cop

Environment. (2013, April 16). Retrieved October 31, 2019, from Maroc.ma website: http://www.maroc.ma/en/content/environement

GermanWatch. "Climate Change Performance Index." germanwatch.org. Accessed July 15, 2019. https://germanwatch.org/en/CCPI.

GIZ. (2019, December 12). Environmental Programme Morocco (PGPE). Retrieved December 13, 2019, from Www.giz.de website: https://www.giz.de/en/worldwide/20169.html

Hafidi, Mohamad. "L'IMPACT ET LA GESTION DES DÉCHETS SOLIDES (RÉGION MARRAKECH-SAFI)." Edited by Helmut Reifeld and Abir Ibourk. Konrad-Adenauer-Stiftung e.V., 2015.

Kawtar Ennaji. (2019, September 19). Morocco World News. Retrieved December 12, 2019, from Morocco World News website: https://www.moroccoworldnews.com/2019/09/283009/zero-mika-vision-plastic-free-morocco/

Kingdom of Morocco. "National Sustainable Development Strategy (NSDS)." Kingdom of Morocco, 2016.

Maroc.ma. Le programme national de gestion des déchets vise à porter le taux de recyclage des déchets à 20%. (2019, January 22). Retrieved from Maroc.ma website: http://www.maroc.ma/fr/actualites/le-programme-national-de-gestion-des-dechets-vise-porter-le-taux-de-recyclage-des-dechets

"Morocco Population 2020 (Live)." *Morocco Population 2020 (Demographics, Maps, Graphs)*, worldpopulationreview.com/countries/morocco-population/.

Parker, Bob. "Planning Analysis: Calculating Growth Rates." Calculating Growth Rates. University of Oregon, September 30, 2020. https://pages.uoregon.edu/rgp/PPPM613/class8a.htm.

Programme National des Déchets Ménagers (PNDM) | Programme National des Déchets Ménagers. (2012). Retrieved December 13, 2019, from Environnement.gov.ma website: http://pndm.environnement.gov.ma/presentation

Soufi, Brahim, and Hamid Chrifi. "Options Des Gestion Des Déchets Solid Municipaux Adaptée Aux Contextes Des Pays Du Sud." Enda Tiers Monde, 2007. https://www.pseau.org/outils/ouvrages/enda_maghreb_options_de_gestion_des_dechets_solides_municipaux_adaptees_aux_contextes_des_pays_du_sud_2008.pdf.

SWEEP-Net. "Rapport Sur La Gestion Des Déchets Solides Au Maroc." Casablanca, Morocco: GIZ, 2014. https://www.resource-recovery.net/sites/default/files/maroc_ra_fr_web.pdf

The World Bank. Morocco: Improving Municipal Solid Waste Management through Development Policy Operations. (2013). Retrieved December 13, 2019, from World Bank website: https://www.worldbank.org/en/results/2013/05/22/morocco-improving-municipal-solid-waste-management-through-development-policy-operations

Waman Consulting. (2011). Mission I: Plan directeur provincial de gestion des déchets ménagers et assimilés de la province d'Al Haouz (Province of Al Haouz & Department of Environment, eds.). Waman Management Consulting.

Waman Consulting. (2014). Mission II: Plan directeur provincial de gestion des déchets ménagers et assimilés de la province d'Al Haouz (Province of Al Haouz & Department of Environment, eds.). Waman Management Consulting.