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# Residents' Perception of Household and Similar Waste Management Practices in Coastal Localities (Dairas) of Annaba District (Wilaya): Annaba, El Bouni and Chétaibi (North-East Algeria)

**Amine Bey Djebar[11], Rafik Kebbab[1], Kaouther Lebdjiri[1], Rachid Amara[2], Hassen Touati[3] and Hocine Frihi[1]**

[1] *EMMAL Laboratory, Badji Mokhtar Annaba University, Badji Mokhtar University, Annaba - Algeria.*
[2] *University of Littoral Côte d'Opale, Dunkerque - France*
[3] *May 8, 1945 University, Guelma - Algeria*

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**Abstract**

In 2023, 46 million Algerians produced around 13 million tons of household and similar waste (HSW), representing a market value of around US$100 million, managed by 5,000 companies. In order to understand the socio-demographic characteristics and context of the residents of 3 coastal localities in the Annaba District, namely Annaba, El Bouni, and Chétaibi. We used an anonymous survey to assess residents' perceptions of the management of their (HSW) and their sorting practices.

A random selection of 36 bins (1,44 kg) of waste was sorted out to show that organic materials are in the majority (62%). At the same time, plastics, paper/cardboard, glass, and metals are informally recycled . Due to a lack of adequate knowledge, the people, surveyed, perceived the time and effort required to sort waste as a constraint rather than a necessity for a comfortable lifestyle. Among married adults, women are more involved in sorting waste than men did, as was observed in both blocks of flats and detached houses.

The idea of living in a household highlights four aspects of household waste management and the dynamics within households: the complexity of waste

[1] Corresponding author's email address: *aminedjebar48@gmail.com*

management, the role of gender, the size of the household, and its motivations and the need for collective solutions. Living in a household is not just about sharing a living space but also about managing domestic, social and environmental challenges together. The more people living in a household, the less motivation there is to sort waste. Biological recovery of organic matter through composting is proposed as the first solution, and almost 80% of those questioned are prepared to make a financial contribution to improving HSW management. Integrated management is needed to clarify the institutional, regulatory, and technical contexts of recovery, recycling, and reclamation systems.

**Keywords**: Annaba, Algeria, management, household waste, social perception.

## 1. Introduction

The size, distribution, and composition of a population on harming the environment, although this relationship is complicated and controversial. According to the World Bank report (2022), HSW is steadily increasing in absolute and per capita terms. Over 2.1 billion tons of waste are produced annually worldwide, and overpopulation will generate over 3.4 billion tons by 2050 (Kaza et al., 2018).

In Algeria, waste management requires a shift towards a circular economy, which is essential if the environmental transition is to be successful. This involves replacing the traditional linear model (produce, consume, discard) with sustainable practices, aimed at transforming waste into resources and rethinking production and consumption patterns. Although many promising waste management policies have been designed and adopted (Bouadam et al., 2022), their implementation has not produced the expected results. Waste remains a major challenge for all regions of the country (National Waste Agency (2020). The costs of waste management and disposal are borne mainly by local authorities, in contradiction

with the polluter-pays principle (Law 30-10 TEOM, revised in the Algerian Finance Law of 2022), which stipulates that the polluter should bear the cost of the nuisance he/she causes.

Annaba District, located in northeastern Algeria and including the seaport coastline, represents a major strategic asset for its socio-economic and human development. However, this fragile ecosystem is constantly threatened by a growth in population and infrastructure saturation, leading to a substantial increase in HSW. Despite the allocation of substantial human, material, and financial resources, HSW management remains questionable, whether in terms of collection, transport, sorting, treatment, disposal, recovery, and satisfaction with the quality of services given.

To promote eco-citizenship in the three coastal localities; Annaba, El Bouni, and Chétaibi, residents can adopt simple gestures, such as reducing waste at sources through selective sorting. Better waste management starts at home, and selective sorting helps to recover recyclable materials and reduce the volume of waste destined for landfills. In addition, municipalities can play a crucial role by involving residents in a composting program for organic waste.

Composting can provide a natural fertilizer for gardens and green spaces, as well as reducing the amount of waste sent to landfill. In short, active participation by residents and municipalities can promote more responsible waste management and help preserve the environment. However, the reality and the practice are completely different. Food scraps that account for 62% of HSW are not sorted (Djebar et al., 2021), unlike metals, bread, paper, and plastics, which have been collected and recycled in recent years by the involvement of the informal sector and economic incentives (Cheniti et al., (2020); Kebaili et al., 2022).

To analyse how socio-professional factors, such as age, income, level of education, type of dwelling, distance, and financial participation influence household behaviour in terms of HSW management, a survey was carried out with the aim of assessing the perception of HSW

management in order to increase the awareness and responsibility of the population and local authorities on this issue.

## 2. Materials and methods

### 2.1 Description of the study area

Annaba is a coastal city, located in the North Eastern of Algeria, extending over 1439 $km^2$, with a population estimated at 609500 in 2021. It is bordered by the Mediterranean Sea to the north and by three districts: Skikda to the west, El Tarf to the east, and Guelma to the south (Fig. 1). It is also a popular tourist destination with a 122.5 km seafront and over 6260 accommodation beds. Annaba District is composed of six localities:three are situated on the coast and the other three inland. Each locality is structured by one or more municipalities, making a total of twelve in the whole district. In this survey, devoted to the perception of HSW management, the three coastal localities were selected: Annaba, El Bouni, and Chétaibi (Fig. 1). In Annaba, waste collection was spatially organized around an administrative division and was carried out in container and door-to-door modes by public industrial and commercial establishments, which is responsible for waste management and improving the living environment of citizens. These are the public establishments for the management of technical landfill centres since 2009, urban improvement (since 2016), and clean Annaba (since 2016) under the authorities of the Directorate of the Environment in Annaba District, which provided us with collection data.

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**Figure 1.** Location of the study area and territorial organisation of Annaba District (Wilaya) North Eastern of Algeria, with its aix localities (Dairas); three coastal: Annaba, El Bouni, and Chetaibi and three inlands: AïnBerda, El Hadjar, and Berrahal.

## 2.2. Waste separation and quantification

To analyse the HSW, a random selection of 36 garbage cans (3/month) was made during 2022, from which 1440 kg of mixed waste was manually sorted. The MODECOM method, proposed by the Waste Management Guide (2002), was used to classify waste, with a few adjustments adapted to local specificities. Waste was classified into six distinct categories according to its nature: organic waste, plastic, paper-cardboard, glass, metals, and complex compounds.

## 2.3. Survey technique and data collection

The anonymous survey was conducted between January and March 2023 in the study areas in order to understand residents' perceptions of HSW management. Random samples from 210 habitats were selected (70 samples/locality). Respondents were interviewed based on a questionnaire adopted and modified by Asante et al., (2016), to obtain information on their sociodemographic profiles, perception of HSW management, and sorting practices (Dlamini et al., 2017). The protocol comprises 19 variables grouped into three series: the first of which aims to determine the socio-demographic profile of respondents by asking seven questions related to

gender (GE), age (AG), number of people in the household (NPH), level of education (LVE), profession (PRF), type of house (TOH) and monthly income (MIC) in Algerian dinar (DZD).

The second series focuses on households' perceptions of HWS management with four questions: quality of the HSW service (QWS), knowledge of an uncontrolled landfill in the commune (KUDC), the acceptable distance for building a waste depot from home (ADWD) and the distance residents are willing to travel to deposit their bottle waste in a specific sorting garbage bin (DTTSS).

The third series aims to understand the relationship between the sociodemographic characteristics of the respondents and their sorting practices through eight questions whether residents buy bottled water and/or drinks in plastic bottles (BPW), Why they buy bottled water in plastic bottles (WBPB), whether they are ready to sort their waste (RSW), whether they are members of an association or would like to join one shortly (MBA), whether they are prepared to pay an extra 1 DZD for a bottle of water (P1ED), whether they agree to contribute financially to waste collection (APFCW), the maximum amount they are prepared to pay/year (MWP/Y), and finally whether they prefer this amount to be included in their electricity bill or a special payment (PAI).

The reliability of the survey was assessed using Cronbach's alpha test (1951), with a result deemed acceptable ($\alpha = 0.8902$).

2.4. Statistical method used

The Rcmdr and Facto Mine R packages of the R software (version 4.1.2 of 2020) were used to analyse the data, collected during the survey on HSW management. Descriptive analyses enabled us to report on the frequency and percentage of sociodemographic characteristics, as well as on the disposal method and households' perceptions of waste management.

The $Chi^2$ goodness-of-fit test was used to determine relationships between categorical variables. Only factor loading values of 0.7 were considered for significant selection and interpretation. Principal component analysis (PCA) was used to identify the grouping of

variables and to determine the interdependent factors within a given concept. We first present the descriptive statistics of all variables before discussing the results of the correlation analysis between sociodemographic factors and respondents' backgrounds on the one hand, and practices and perceptions regarding HSW management, on the other hand, before presenting the results of PCA.

## 3. Results

The three studied localities comprised a total population of 511139 inhabitants who generated an average of 120807 tons of HSW in 2022 (0.66 kg/inhabitant/day). The highest volume of waste was reached during the Ramadan period which was 11395 tons. A family of three to four people produces between two and three kg of HSW per day, with the largest fraction being organic matter, reaching 62%. Complex compounds accounted for 17%, followed by plastics (10%), paper and cardboard (8%), various metals (1%), and glass (2%) (Fig. 2). On the beaches of the three districts, 90% of the HSW was made up of plastics, particularly protective masks (polypropylene and rubber), and other packaging used for beverages and domestic needs.

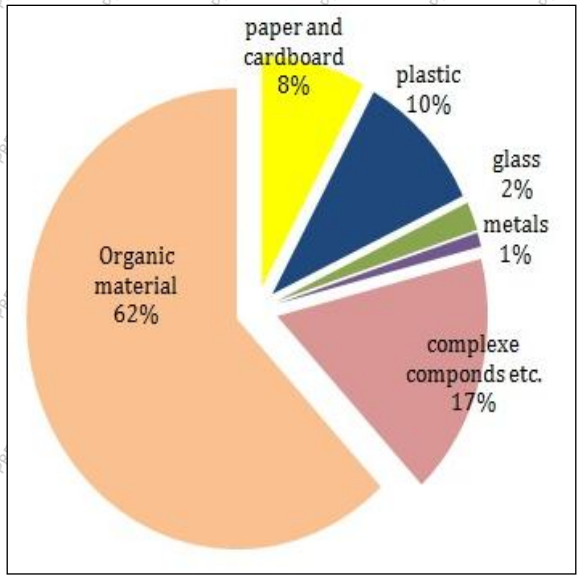


**Figure 2.** Distribution of household and similar waste discharged by the populations of the three coastal localities of Annaba: Annaba, El Bouni, and Chétaibi

### 3.1 Data analysis

3.1.1 Sociodemographic characteristics and respondents' backgrounds

The majority of respondents were male (N = 168; 80%), married (N = 129; 61%), and 28% were aged between 25 and 35 years. In the three coastal towns, the majority of households consisted of two (32%) to three (36%) persons. Respondents with primary education (N = 66) accounted for 31% of the respondents, followed by those with secondary education (30%, N = 62), and those with university education (22%, N = 46). Approximately 26% of respondents work in the public sector, 46% live in apartment blocks, and 39% (N = 82) earn between DZD 21,000 and DZD 40,000 per month, with the highest number of salaries above DZD 100,000 in Annaba District (Table 1). The chi-squared test showed a highly significant difference between the coastal districts only for the type of housing (TOH) ($\chi^2 = 30.68$; $p < 0.001$).

Gender was highly correlated, respectively, with MBA (r = 0.99), PRF (r = 0.98), DTTSS (r = 0.97), RSW (r = 0.96), BPW (r = 0.95) and APFCW (r = 0.91). It remains strongly correlated with PAI (r = 0.87) and the residents' age (r = 0.75). This variable is negatively correlated with NPH (r = -0.97), MIC (r = -0.88), and LVE (r = -0.86) (Annex).

Age (AG) was highly correlated with seven variables. PRF had the highest correlation (r = 0.8202), followed by BPW (r = 0.8092), RSW (r = 0.7773), MBA (r = 0.7729), GE (r = 0.7528), APFCW (r = 0.7509), and MWP/Y (r = 0.7458). However, age was negatively correlated with NPH (r = -0.8219).

The number of individuals in the household (NPH) was strongly correlated with LVE (r = 0.86), followed by MIC (r = 0.81) and ADWD (r = 0.80). This parameter was negatively correlated with nine variables, almost perfectly correlated with RSW (r = -0.99), BPW (r = -0.98), MBA (r = -0.97), APFCW (r = -0.97), GE (r = -0.9700), PRF (r = -0.96), DTTSS (r = -0.92), and finally, MWP/Y (r = -0.91). The NPH was also negatively correlated with age (r =-0.82) and PAI with a correlation coefficient of r = -0.76 (Annex).

The level of education (LVE) was positively correlated with NPH (r = 0.86), P1ED (r= 0.78), WBPB (r = 0.77), and ADWD (r = 0.74). This variable was negatively correlated with the following variables, respectively: DTTSS (r= -0.93), MBA (r = -0.87), PRF (r = -0.86), GE (r = -0.86), BPW (r = -0.8643), RSW (r = -0.86), MWP/Y (r = -0.83), APFCW (r = -0.82), and PAI (r = -0.70). Profession (PRF) was highly correlated with six variables: MBA (r = 0.98), GE (r =0.98), BPW (r = 0.97), DTTSS (r = 0.96), MWP/Y (r = 0.96), and RSW (r = 0.95). This variable remains positively correlated with APFCW (r = 0.89), age (r = 0.82), and PAI with a correlation coefficient of r = 0.80.

Our results show a highly significant and inversely proportional correlation between PRF and NPH (r = -0.96), LVE (r = -0.86), MIC (r = -0.85), the ADWD (r = -0.84), and P1ED with r = -0.73. The type of housing (TOH) was negatively correlated with the QWS quality of HSW service in the locality (r = -0.93) (Annex). Monthly income (MIC) was positively correlated with NPH (r = 0.81), ADWD (r =0.80), and P1ED (r = 0.70). This parameter was negatively correlated with nine variables: MBA (r = -0.88), GE (r = -0.88), BPW (r = -0.86), RSW (r = -0.86), PRF (r = -0.85), MWP/Y (r = -0.82), DTTSS (r = -0.82), APFCW (r = -0.80), and PAI (r = -0.75) (Annex).

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**Table 1.** Sociodemographic characteristics and respondents' backgrounds in three coastal localities of the District of Annaba (N = 210).

| Variable | Description | Coastal localities | | | F. (N) | % | $\chi^2$ (p-value) |
|---|---|---|---|---|---|---|---|
| | | Annaba | El Bouni | Chétaibi | | | |
| GE | Male | 52 (37M) | 55 (42M) | 61 (50M) | 168 | 80 | 3.75 (0.15) |
| | Female | 18 (12M) | 15 (11M) | 09 (5M) | 42 | 20 | |
| AG | 25-35 | 20 | 17 | 22 | 59 | 28 | 8.53 (0.38) |
| | 35-45 | 11 | 13 | 16 | 40 | 19 | |
| | 45-55 | 19 | 12 | 14 | 45 | 21 | |
| | 55-65 | 17 | 18 | 13 | 48 | 23 | |
| | 65-75 | 03 | 10 | 05 | 18 | 09 | |
| NPH | 1 | 04 | 06 | 03 | 13 | 06 | 6.38 (0.89) |
| | 2 | 24 | 22 | 21 | 67 | 32 | |
| | 3 | 20 | 27 | 29 | 76 | 36 | |
| | 4 | 12 | 08 | 06 | 26 | 12 | |
| | 5 | 06 | 04 | 06 | 16 | 08 | |
| | 6 | 02 | 02 | 03 | 07 | 03 | |
| | 7 and + | 02 | 01 | 02 | 05 | 02 | |
| LVE | University and + | 18 | 13 | 15 | 46 | 22 | 3.24 (0.91) |
| | High school student | 24 | 20 | 22 | 66 | 31 | |
| | Secondary | 19 | 22 | 21 | 62 | 30 | |
| | Primary | 07 | 10 | 08 | 25 | 12 | |
| | Others | 02 | 05 | 04 | 11 | 05 | |
| PRF | Public function | 16 | 19 | 19 | 54 | 26 | 4.93 (0.96) |
| | Liberal profession | 06 | 03 | 05 | 14 | 07 | |
| | Trader | 09 | 11 | 11 | 31 | 15 | |
| | Farmer | 08 | 10 | 10 | 28 | 13 | |
| | Worker | 15 | 11 | 13 | 39 | 19 | |
| | Retirement | 14 | 12 | 08 | 34 | 16 | |
| | Unemployed | 02 | 04 | 04 | 10 | 05 | |
| TOH | Individual house | 18 | 16 | 42 | 76 | 36 | 30.68 (0.00)*** |
| | Building | 37 | 44 | 16 | 97 | 46 | |
| | Traditional house | 15 | 10 | 12 | 37 | 18 | |
| MIC | - 20 000 DZD | 03 | 05 | 12 | 20 | 10 | 23.56 (0.09) |
| | 21 to 40 000 | 19 | 27 | 36 | 82 | 39 | |
| | 41 to 60 000 | 22 | 16 | 11 | 49 | 23 | |
| | 61 to 80 000 | 08 | 06 | 03 | 17 | 08 | |
| | 81 to 100 000 | 06 | 07 | 03 | 16 | 08 | |
| | 101 to 120 000 | 05 | 05 | 02 | 12 | 06 | |
| | 121 to 140 000 | 04 | 02 | 01 | 07 | 03 | |
| | 141 to 160 000 | 02 | 01 | 01 | 04 | 02 | |
| | + 161000 | 01 | 01 | 01 | 03 | 01 | |

*: Significant difference, **: highly significant, ***: very highly significant**.** (GE) Gender, (AG) Age, (NPH) Number of People in the Household, (LVE) Level of Education, (PRF) Profession, (TOH) Type of House, and Monthly Income (MIC) in Algerian Dinar (DZD).

3.1.2. Household Practices and Perceptions Regarding HSW Management

Approximately, 45% of households (N = 94), where the majority live in Annaba District (N = 37) and El Bouni (N = 32), consider the quality of solid waste management service to be good (Table 2). Furthermore, half of the residents are unaware of the existence of illegal dumpsites in their respective localities, 40% of them accept the construction of a landfill 5 km away from their homes, and 45% do not want to travel more than 100 m to deposit their bottles in a specific sorting bin. In the three localities, only 7% of the respondents are willing to travel more than 1000 m to do so. The Chi-square test shows no significant difference between the variables of household practices and perceptions regarding solid waste management in the four cases, $p > 0.05$ (Table 2).

Quality of the HSW service (QWS) was highly negatively correlated with the TOH (r= -0.93), while knowledge of illegal dumpsites (KUDC) was not correlated with any variables (Annex). The accepted distance for the construction of a solid waste management landfill (ADWD) was strongly positively correlated with the P1ED (r = 0.93). However, it was strongly correlated with NPH (r = 0.80), MIC (r = 0.80), and LVE (r = 0.74). Quality of the HSW service (QWS) was also highly negatively correlated with BPW (r = -0.90), PRF (r = -0.84), RSW (r = -0.83), MBA (r = -0.81), APFCW (r = -0.80), DTTSS (r = -0.77), and GE (r = -0.77).

The distance to travel to deposit bottle waste in a specific sorting bin (DTTSS) was highly correlated with GE (r = 0.97), PRF (r = 0.96), MBA (r = 0.96), MWP/Y (r = 0.96), BPW (r =0.92), and willingness to sort waste (r = 0.91). This relationship remains strongly positively correlated with two variables: PAI (r = 0.86) and APFCW (r = 0.84). However, there was a strong negative correlation between LVE (r = -0.93) and the number of individuals in the household (r = -0.92). This variable also remains negatively correlated with MIC (r = -0.82), ADWD (r = -0.77), and P1ED (r = -0.74) (Annex).

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**Table 2.** Correlation between Household Practices and Perceptions Regarding HSW Management (N = 210).

| | | Coastal localities | | | | | |
|---|---|---|---|---|---|---|---|
| Variable | Description | Annaba | El Bouni | Chétaibi | F. (N) | % | $\chi^2$ (p-value) |
| QWS | Good | 37 | 32 | 25 | 94 | 45 | 9.07(0.06) |
| | Average | 29 | 25 | 36 | 90 | 43 | |
| | Bad | 04 | 13 | 09 | 26 | 12 | |
| KUDC | Yes | 39 | 31 | 34 | 104 | 50 | 1.86(0.40) |
| | No | 31 | 39 | 36 | 106 | 50 | |
| ADWD | 1 Km | 16 | 12 | 23 | 51 | 24 | 8.48(0.20) |
| | 5 Km | 28 | 31 | 26 | 85 | 40 | |
| | 10 Km | 16 | 22 | 17 | 55 | 26 | |
| | + 10 Km | 10 | 05 | 04 | 19 | 09 | |
| DTTSS | - 100m | 26 | 35 | 34 | 95 | 45 | 11.26(0.18) |
| | 100 to 300m | 15 | 15 | 12 | 42 | 20 | |
| | 300 to 500m | 12 | 9 | 10 | 31 | 15 | |
| | 500 to 1000m | 13 | 06 | 09 | 28 | 13 | |
| | + 1000m | 04 | 05 | 05 | 14 | 07 | |

(QWS) Quality of the HSW service, (KUDC) knowledge of an uncontrolled landfill in the commune, (ADWD) The acceptable distance for building a waste depot from home and thedistance residents are willing to travel to deposit their bottle waste in a specific sorting garbage bin (DTTSS).

3.1.3. Relationship between sociodemographic characteristics, respondents' Background, and Household Practices (HSW Sorting Practices)

The eight sets of data illustrate the relationship between sociodemographic characteristics, respondents' background, and household practices. Our results show that 93% (N = 196) of respondents purchase water and/or soft drinks in plastic bottles, and 75% do so because they believe tap water is polluted. The majority of residents (82%; N = 173) are willing to sort their waste, and 84% are members of an association or would like to join one soon. 52% of respondents in both the localities of Annaba and El Bouni or Chétaibi are willing to pay up to 2 DZD extra for the purchase of a bottle of water, 79% are willing to contribute financially to solid waste management collection, 73% are willing to spend up to 1000 DZD / year, and 66% would like this amount to be integrated into water or electricity bills for practical reasons (Table 3).

The Chi-square test showed that there were five significant differences among the eight selected variables. These differences pertain to the purchase of water and/or soft drinks in plastic bottles with a $\chi^2$ of 10.25 ($p < 0.001$), acceptance of paying one DZD for the purchase of a bottle of water with a $\chi^2$ of 30.50 ($p = 0.000$), financial participation in solid waste management collection with a $\chi^2$ of 8.31 ($p > 0.01$), maximum amount accepted to pay per year with a $\chi^2$ of 18.43 ($p < 0.001$), and the preference for integrating financial participation into electricity or water bills with a $\chi^2$ of 15.87 ($p < 0.001$) (Table 3).

Purchasing water and/or soft drinks in plastic bottles (BPW) was very highly correlated with RSW (r = 0.98), MBA (r = 0.97), PRF (r = 0.97), APFCW (r = 0.95), GE (r = 0.95), DTTSS (r = 0.92), and MWP/Y (r = 0.89). This parameter was highly correlated with age (r = 0.80) and PAI (r = 0.70). This variable was very highly negatively correlated with NPH (r = -0.98) and ADWD (r = -0.90). It was strongly correlated with the LVE (r = -0.86), MIC (r = -0.86) and P1ED (r = -0.78) (Annex). The reason for purchasing water in plastic bottles (WBPB) was strongly positively correlated with LVE (r = 0.77).

The willingness to sort waste (RSW) was also highly positively correlated with the BPW (r = 0.98), APFCW (r = 0.98), MBA (r = 0.97), GE (r = 0.96), PRF (r = 0.95), DTTSS (r = 0.91), and MWP/Y (r = 0.90). It was also correlated with age (r = 0.77) and PAI (r = 0.75). This relationship was strongly negatively correlated with NPH (r = -0.99), LVE (r = -0.86), MIC (r= -0.86), ADWD (r = -0.83), and P1ED (r = -0.70).

Being a member of an association or planning to join one soon (MBA) was highly correlated with 7 variables: gender (r = 0.99), PRF (r = 0.98), RSW (r = 0.97), BPW (r =0.97), DTTSS (r = 0.96), MWP/Y (r = 0.96), and APFCW (r = 0.92). With the preference for PAI (r = 0.84), this variable remains strongly correlated. However, it was strongly negatively correlated with the NPH (r = -0.97), MIC (r = -0.88), LVE (r = -0.87), ADWD (r = -0.81) and P1ED (r = -0.70).

Acceptance of paying one DZD extra for the purchase of one bottle of water (P1ED) was strongly positively correlated with ADWD (r = 0.93), LVE (r = 0.78), and MIC (r = 0.70). However, it was negatively correlated with BPW (r = -0.78), DTTSS (r = -0.74), PRF (r = -0.73) and MBA (r = -0.70).

Acceptance of financial participation in the collection of solid waste (APFCW) was positively correlated with eight variables: RSW (r = 0.98), BPW (r = 0.95), MBA(r = 0.92), GE (p = 0.91), and PRF (r = 0.89), DTTSS (r = 0.8429), MWP/Y (r = 0.82), and age (r = 0.75). However, it was strongly negatively correlated with NPH (r = -0.97), LVE (r = -0.82), ADWD (r = -0.80) and MIC (r = -0.80). The maximum amount you would be willing to pay per year (MWP/Y) was positively correlated with gender (r = 0.97), MBA (r = 0.96), DTTSS (r = 0.96), PRF (r = 0.96), PAI (r= 0.93), RSW (r = 0.90), and BPW (r = 0.89). It was also positively correlated with APFCW (r = 0.82) and age (r = 0.74). On the contrary, it was negatively correlated with NPH (r = -0.91), level of education (r = -0.83), and MIC (r = -0.82).

The preference for the payment to be integrated into electricity bills or in a special payment (PAI) was strongly correlated with MWP/Y(r = 0.93), and it was strongly correlated with six variables: GE (r = 0.87), DTTSS (r = 0.86), MBA (r = 0.84), PRF (r = 0.80), RSW (r =

0.75), and BPW (r = 0.70). This preference was strongly negatively correlated with NPH (r = -0.76), MIC (r = -0.75), and LVE (r = -0.70) (Annex).

**Table 3.** Correlation between socio-demographic characteristics of respondents and HSW management practices (Waste Sorting Practices).

| | | Coastal localities | | | | | |
|---|---|---|---|---|---|---|---|
| Variable | Description | Annaba | El Bouni | Chétaibi | F. (N) | % | $\chi^2$ (p-value) |
| BPW | Yes | 67 | 69 | 60 | 196 | 93 | 10.25 (0.000)*** |
| | No | 03 | 01 | 10 | 14 | 07 | |
| WBPB | Have a baby | 09 | 07 | 6 | 22 | 10 | 4.00 (0.400) |
| | Have a sick | 13 | 06 | 11 | 30 | 14 | |
| | Polluted tap water | 48 | 57 | 53 | 158 | 75 | |
| RSW | Yes | 61 | 55 | 57 | 173 | 82 | 1.83 (0.390) |
| | No | 9 | 15 | 13 | 37 | 18 | |
| MBA | Yes | 55 | 59 | 62 | 176 | 84 | 2.59 (0.270) |
| | No | 15 | 11 | 08 | 34 | 16 | |
| P1ED | 1 DZD | 25 | 10 | 32 | 67 | 32 | 30.50 (0.000) *** |
| | 2 | 37 | 37 | 35 | 109 | 52 | |
| | 5 | 08 | 23 | 3 | 34 | 16 | |
| APFCW | Yes | 63 | 50 | 52 | 165 | 79 | 8.31 (0.010)* |
| | No | 07 | 20 | 18 | 45 | 21 | |
| MWP/Y | 1000 DZD | 41 | 49 | 63 | 153 | 73 | 18.43 (0.001)** |
| | 2000 | 19 | 10 | 05 | 34 | 16 | |
| | + 2000 | 10 | 11 | 02 | 23 | 11 | |
| PAI | Electricity water bills | 38 | 42 | 59 | 139 | 66 | 15.87 (0.000) *** |
| | Special payment | 32 | 28 | 11 | 71 | 34 | |

*: Significant difference, **: highly significant, ***: very highly significant

(WPW) Do they buy bottled water and/or drinks in plastic bottles? (WBPB) Why do they buy bottled water? (RSW) Are they prepared to sort their waste? (MBA) Are they members of an association or would like to join one shortly? (P1ED) Are they prepared to pay one Algerian Dinar (DZD) more for a bottle of water? (APFCW) Are they willing to contribute financially to waste collection? (MWP/Y) Are they willing to pay the maximum amount per year? (PAI) Do they prefer this amount to be included in their electricity bill or to be the subject of a special payment?

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**Annex.** Matrix of correlations of sociodemographic variables, household practices and perceptions regarding HSW Management.

| | AG | MBA | BPW | P1ED | KUDC | RSW | DTTSS | ADWD | APFCW | PAI | TOH | LVE | NPH | WBPB | PRF | QWS | MIC | GE | MWP.Y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AG | 1.0000 | | | | | | | | | | | | | | | | | | |
| MBA | 0.7729 | 1.0000 | | | | | | | | | | | | | | | | | |
| BPW | 0.8092 | 0.9744 | 1.0000 | | | | | | | | | | | | | | | | |
| P1ED | -0.4381 | -0.7080 | -0.7844 | 1.0000 | | | | | | | | | | | | | | | |
| KUDC | -0.1587 | -0.1813 | -0.1085 | 0.3309 | 1.0000 | | | | | | | | | | | | | | |
| RSW | 0.7773 | 0.9774 | 0.9857 | -0.7012 | 0.0088 | 1.0000 | | | | | | | | | | | | | |
| DTTSS | 0.6804 | 0.9691 | 0.9237 | -0.7476 | -0.3122 | 0.9161 | 1.0000 | | | | | | | | | | | | |
| ADWD | -0.6733 | -0.8138 | -0.9023 | 0.9385 | 0.2334 | -0.8300 | -0.7766 | 1.0000 | | | | | | | | | | | |
| APFCW | 0.7509 | 0.9270 | 0.9596 | -0.6632 | 0.1691 | 0.9853 | 0.8429 | -0.8067 | 1.0000 | | | | | | | | | | |
| PAI | 0.5130 | 0.8426 | 0.7004 | -0.3559 | -0.2765 | 0.7501 | 0.8609 | -0.4139 | 0.6581 | 1.0000 | | | | | | | | | |
| TOH | -0.4245 | -0.1782 | -0.3791 | 0.6029 | 0.0744 | -0.2584 | -0.1050 | 0.6775 | -0.2991 | 0.3554 | 1.0000 | | | | | | | | |
| LVE | -0.5494 | -0.8741 | -0.8643 | 0.7883 | 0.1449 | -0.8621 | -0.9375 | 0.7483 | -0.8233 | -0.7062 | 0.1509 | 1.0000 | | | | | | | |
| NPH | -0.8219 | -0.9772 | -0.9802 | 0.6639 | 0.0111 | -0.9942 | -0.9209 | 0.8015 | -0.9753 | -0.7621 | 0.2383 | 0.8638 | 1.0000 | | | | | | |
| WBPB | -0.0966 | -0.5088 | -0.4548 | 0.3296 | -0.2872 | -0.5402 | -0.5941 | 0.2220 | -0.5556 | -0.5460 | -0.3185 | 0.7712 | 0.5428 | 1.0000 | | | | | |
| PRF | 0.8202 | 0.9892 | 0.9733 | -0.7396 | -0.2809 | 0.9546 | 0.9699 | -0.8422 | 0.8933 | 0.8061 | -0.2540 | -0.8696 | -0.9623 | -0.4421 | 1.0000 | | | | |
| QWS | 0.3872 | 0.0453 | 0.2495 | -0.3434 | 0.1576 | 0.1619 | -0.1020 | -0.5045 | 0.2378 | -0.4577 | -0.9309 | 0.0944 | -0.1393 | 0.4690 | 0.0956 | 1.0000 | | | |
| MIC | -0.5421 | -0.8892 | -0.8620 | 0.7094 | 0.2051 | -0.8600 | -0.8288 | 0.8003 | -0.8080 | -0.7584 | 0.1864 | 0.6797 | 0.8172 | 0.2969 | -0.8546 | -0.1037 | 1.0000 | | |
| GE | 0.7528 | 0.9977 | 0.9577 | -0.6712 | -0.1790 | 0.9690 | 0.9701 | -0.7749 | 0.9150 | 0.8761 | -0.1111 | -0.8683 | -0.9700 | -0.5299 | 0.9815 | -0.0163 | -0.8875 | 1.0000 | |
| MWP.Y | 0.7458 | 0.9680 | 0.8927 | -0.5790 | -0.2980 | 0.9040 | 0.9648 | -0.6741 | 0.8247 | 0.9340 | 0.0152 | -0.8320 | -0.9197 | -0.5041 | 0.9618 | -0.1536 | -0.8296 | 0.9789 | 1.0000 |

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3.2. Principal Component Analysis (PCA) of the studied coastal localities

The factorial plots of the first two principal axes clearly showed a distinct inter-locality variation (Fig. 3). Together, they explain 64.14% of the total variation. The first principal axis explains 45.14% of the total variation and was positively correlated with 10 variables: gender (r = 0.98), MBA (r = 0.98), RSW (r = 0.97), BPW (r = 0.97), APFCW (r = 0.92), MWP/Y (r = 0.84), PAI (r = 0.80), PRF (r = 0.74), DTTSS (r = 0.59), MIC (r = -0.613), and age (r = 0.49) (Fig. 3). However, this axis was negatively correlated with NPH (r = -0.610), ADWD (r = -0.51), and weakly correlated with LVE (r = -0.36) and KUDC (r = -0.17). The second principal axis explains 19% of the total variation and was positively correlated with four variables: PE1D (r = 0.81), QWS (r = 0.78), TOH (r = 0.77), and strongly negatively correlated with WBPB (r = -0.92) (Fig. 3).

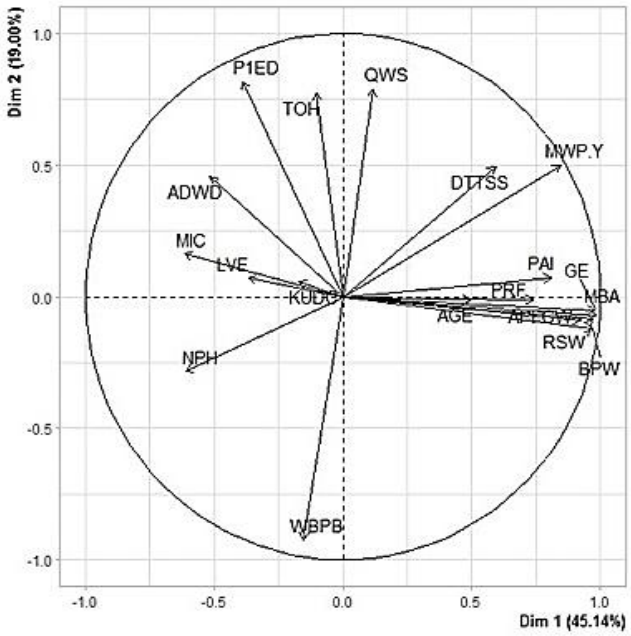


**Figure 3.** Principal Component Analysis representation of the 3 coastal localities of Annaba: Annaba, El Bouni, and Chétaibi.

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The factorial plot of the first two principal axes clearly showed an inter-locality variation, where the two axes together explain 64.14% of the total variation (Fig. 4).

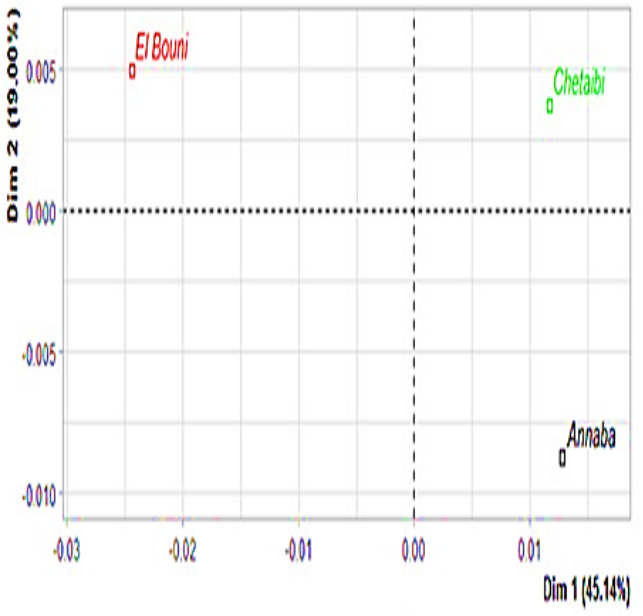


**Figure 4.** Representation of an inter-locality factorial plot.

## 4. Discussion

Due to the complexity of its treatment and the associated environmental risks, the management of waste electrical and electronic equipment is a major challenge (Haniyeh et al., 2021). Despite this, scientists and sociologists often do not show much interest in this issue. In this context, a survey consisting of (19) questions was conducted among residents of three coastal localities in the Annaba district in northern Algeria: Annaba, El Bouni, and Chétaibi. This study allowed for the analysis of HSW composition, evaluation of residents' perceptions, and a better understanding of the sociodemographic characteristics and backgrounds of the respondents. The obtained results will help tailor HSW management program planning to the specific needs of the population.

Organic waste, which accounts for 62% of the waste, disposed of by the populations of Annaba's three coastal localities, reflects a trend widely observed in most developing countries, as highlighted by numerous authors (Campuzano and Gonzalez-Martinez (2016), Fadhullah et al., (2022), and Ulloa-Murillo et al., (2022). It can also be seen in the Report on the Solid Waste Management in Algeria (2014). This type of waste generates unpleasant odors and attracts insects and rodents. However, it can be composted to produce a residue rich in humus and mineral compounds. To encourage this practice, it is suggested to provide each household with a distinct-colored bin, labelled with an explanatory manual in Arabic and French, containing simple drawings showing the step-by-step process. Additionally, it would be useful to install large-capacity collection and composting bins for organic waste in each neighbourhood.

For over four years, (21) companies, specializing in the recovery and recycling of metals, paper cardboard, and various types of plastics have been operating in the Annaba District. Thanks to their activity, these wastes have been maintained at respective rates of 1%, 8%, and 10%, while complex compounds such as textiles, shoes, hazardous waste, inert diapers, and other disposable products reached 17%. However, it should be noted that the majority of

waste collection activities for these HSW were informal.For example, a kilogram of plastic bottles (PET) is currently sold for between 70 and 100 DZD.

The second objective of this study was to determine the socio-professional variables that influence the behaviour of respondents, especially in terms of waste sorting and participation in improving HSW management in their localities. The perception and behaviour of a population regarding the management of HSW in a coastal environment were explored through a simple survey. According to Sawaya et al., (2023) and Rai et al., (2021), individual perception was shaped by the context and current situation, as well as values, moods, social circumstances, and individual expectations.

Currently, the majority of respondents do not sort their waste, except for metals (high demand by type), bread (religious belief compliance), and plastic (increased awareness). However, out of the (210) residents of the three coastal districts of Annaba, N = 173 (82%) are willing to sort their waste in the future. This particularity gives us hope that it is possible to increase waste sorting practices and expand them to other HSW. The respondents lack adequate knowledge of the crucial importance of source waste sorting. They are unaware that the volume of HSW dumped in landfills is constantly increasing, thereby, jeopardizing the remaining space in technical landfills at a rapid pace. According to studies, it is important to consider gender differences and traditional roles to encourage household participation in waste management. The correlations between the selected parameters can be explained by socio-economic, cultural and behavioural factors. For example, larger households may have a higher total income because several members contribute financially. At higher income levels, household size often decreases due to educational, occupational, and family choices, influenced by access to more resources. It has been found that young couples often start with lower incomes and smaller. According to our observations, the type of housing strongly influences HSW management practices and perceptions. People, living in apartment buildings (46%) and individual houses (36%), are more likely to sort their waste, as reported by Vassanadumrongdee and

Kittipongvises (2018). These two types of housing accommodate respondents with high and medium incomes in the three coastal districts of Annaba, where waste collection services are well-provided. Contrary to the suggestions of Adeoti Adetola et al., (2010), economic considerations do not seem to play a major role in the perceptions and attitudes of respondents regarding HSW management practices. However, during our interviews, we found that the higher the monthly income of the interviewed person or the total household income is, the higher their value of financial participation in HSW management will be. Low income has a negative influence on respondents' perceptions and attitudes toward the quality of HSW management in their district, as suggested by Parfitt et al., (197) and Kaoje et al., (2017).

We also noticed that the number of people in the household influences waste sorting. Households with one to three people tend to have more significant eco-friendly behaviours than households with four or more people. This result is similar to that of the study by Addo et al., (2017), who reported that households with more than four people were less likely to engage in waste management practices compared to households with fewer than four people. In contrast, Osbjer et al., (2015) associated waste management practices with a higher number of people in households, which could be due to the need to handle waste generated by larger populations within the household. For sustainable HSW management, local policies should no longer be limited to waste collection and transportation to landfills. It is essential to focus on understanding, instilling, and involving the population in source waste sorting and collection.

## 5. Conclusions

Improving household waste sorting practices in Annaba, El Bouni, and Chétaibi requires a comprehensive, multi-dimensional approach. Local authorities must prioritise initiatives such as large-scale composting, improving accessibility to selective collection points and promoting community involvement in sustainable waste management. Integrating these efforts with the principles of the circular economy, supported by public-private partnerships and the development of innovative infrastructure, can significantly improve the efficiency of waste management systems. In addition, strict regulations, such as a ban on single-use plastics and

targeted education campaigns, will play a key role in the adoption of environmentally friendly behaviour. Together, these measures can turn waste management into a cornerstone of environmental protection and improved living conditions for local people. Municipalities must take specific measures to improve waste management. This includes adopting community and local approaches, such as setting up waste management cooperatives and building modern treatment facilities. Finally, education and awareness-raising play a key role, with programmes aimed at schools and communities to encourage waste sorting and reduction at source.

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