Macro wastes cluttering the coastline of Annaba city (north-east Algeria): preliminary socio-economic survey

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Abstract. Environmental protection has been an issue for environmentalists and governments in recent years. Annaba, the third largest coastal city in Algeria with 400 x 10^3 inhabitants, has experienced major environmental changes in recent years. Indeed the acceleration of the urbanization phenomenon, and the movements of migration towards the city, has caused an increase in the quantities of macrowastes (plastics, glass, metals, etc.) and the emergence of wild dumps and black dots. Thus, between 0.7 and 0.8 kg of synthetic macro-debris composed of metals, papers/ cardboards, glasses, textiles and plastics per capita are daily abandoned on public roads, where some are run onto the shores. The recovery and recovery rates as well as the deficiencies observed in the main landfill Berkazerka are the principle causes. The problem of macro-wastes is a cross-cutting approach, intersecting the approaches of the exact and the social sciences. It involves categorizing and understanding the role of natural factors on which they depend, but also, to detect and adjust certain social behaviors. Dealing with the problem of macro-wastes, therefore, involves identifying, understanding and adapting social, individual and collective behaviors. To compensate for the lack of quantitative and qualitative information on these macro-wastes, a survey of local stakeholders was conducted. The survey gave the following results: synthetic macro-waste were composed of plastics, glass, metal, wood, textiles/paper and household are stranded on the coast; the quality and the proportions vary according to the places; plastic is always the highest percentage; the abandonment of waste outside the trash and improper public management constitute the main origins.
Key Words: macrowaste, environment, management, Annaba.

Introduction. The environment arises as a new space of discussion between actors of various horizons (environmental associations, unions, local authorities, state representatives, etc.) on the measures to be taken to build together an inhabitable environment (Gareau 2001). Our environment is our life support and all its components; air, water, atmosphere, rocks, soils, plants and animals. Over the last thirty years, our relationship with nature has changed radically; the environment is fragile and its balance is dependent on human activity. The massive increase in human population in cities has created problems very similar to those evoked by industrialization, in which air and water pollutions are the counterparts of ever-increasing intense activities. Environmental degradation affects several ecological dimensions as deforestation, desertification, loss of biodiversity, deprivation of water resources, urban wastes, etc. (Brunet 2010).

More than 80% of landfills in southern and eastern Mediterranean countries are not controlled. The Mediterranean marine environment is particularly vulnerable to the dumping of agricultural wastes, airborne particles and runoff containing pathogens, heavy metals, organic matter, oils and radioactive substances (MeHSIP 2008).

Rapid urbanization combined with the gradual development of unsustainable tourism along the Mediterranean coast has resulted in serious environmental and health problems. Pollution induced by industrial activities, maritime transport, with the passage of 30% of the world maritime traffic (Gallini 2008) and the domestic activities with discharges at sea estimated at 610^5 tons each year, the equivalent of 30 disasters of the

"Erika" type (Gallini 2008), the disappearance of pristine areas and the destruction of coastal ecosystems by real estate projects have also contributed to this degradation (MeHSIP 2008).

The Algerian coastline of 1622 km alternating rocky shores, sandy beaches and wetlands, is highly populated. The role of the industries in the development of the national economy is unavoidable; however, the latter monopolize the best coastal sites at the expense of the sea coastline. It brings real risks for the contiguous neighboring agglomerations and the marine environment (Kacemi 2006).

The coastal city of Annaba province suffers the same environmental problems as the rest of the Algerian coastline. It is exposed to different types of anthropogenic pollution. Located in the east of the country, it stretches over 1412 km^2 open on the Mediterranean coast along 80 km. It had in 2015 (Algerian Demography N°740) around 400 10^3 inhabitants spread over 6 daïras (Annaba, El Bouni, El Hajar, Chetaibi, Ain el Berda and Berrahal) and 12 municipalities (Annaba, El Bouni, El Hadjar, Sidi Ammar, Seraidi, Ain Berda, Cheurfa, El Eulma, Berrahal, Oued Elaneb, Treat, and Chetabi). The population is particularly concentrated in the city of Annaba, El Bouni, El Hadjar and Sidi Ammar, which represent the most important industrial zones.

In Annaba province, solid waste management is one of the main causes of pollution that has serious consequences in terms of health risks (mosquito breeding grounds, rat proliferation, etc.), environmental impact (appearance, odor, pollution of water and air), social, toxicity (especially for medical waste and heavy metals), infrastructure (uncollected waste blocks the pipes) and unsanitary spaces (INVS 2004). Thus, the production of household waste per capita per day increases year by year because of economic growth, resulting in greater consumption and bigger production of wastes.

The average amount of household waste produced in Annaba city is in the order of 0.7 to 0.8 kg / inhabitant / day in urban areas and 0.5 kg / inhabitant / day in rural areas (APC Annaba 2014). It is within this framework that we have chosen to investigate the cumbersome macrowastes along the coastline of Annaba city.

Material and Method

Location of Annaba province. The Annaba region occupies a strategic position on the northern southwestern coast of the Mediterranean Sea. It is limited to the North by the Mediterranean Sea, to the South by the province of Guelma, to the East by the province of Tarf and to the West by the province of Skikda. The province of Annaba (Figure 1) is a group of coastal agglomerations of North-East Algeria, 4th city after Algiers, Oran and Constantine. The population is particularly concentrated in the communities of Annaba, El Bouni, El Hadjar and Sidi Ammar (Table 1). Annaba is one of the main tourist destinations in Algeria (Hammoudi 2014).

Table 1

GPS locations of the 8 study stations selected of Annaba province

Station	*Type*	*GPS position*	*Municipality*
1	Sidi Ammar	36°48'52.22'' N; 07°43'06.49'' E	Sidi Ammar
2	Sidi Achour	36°52'13.79'' N; 07°43'04.91'' E	El Bouni
3	El Bouni	36°51'48.81'' N; 07°43'43.62'' E	El Bouni
4	INESSM	36°54'46.46'' N; 07°44'46.35''E	Annaba
5	Sidi salem	36°51'42.79'' N; 07°46'42.26'' E	El Bouni
6	Joinoville	36°52'52.50'' N; 07°45'36.87'' E	El Bouni
7	Corniche	36°55'28.49'' N; 07°45'44.18'' E	Annaba
8	Educational institutions	Primary, middle and secondary schools	Annaba

Figure 1. Location of Annaba province (meteorological service, Les Salines - Annaba, 2012).

Location of the study stations. Up to eight sites were chosen to carry out the survey (Figure 2 and Table 1) and to represent the different areas of the populations.

Figure 2. Position of the study stations selected (yellow dots) of Annaba city. Google earth modified (2017).

Presentation of Annaba city. Annaba (ancient Hippone, Bone) is the chief municipality of Annaba province. It lies between longitudes 06°03' East and latitudes 41°0' North, 158 km northeast of Constantine, 246 km east of Jijel and about 100 km west of Tunisian border (DUC 2012).

Subdivision of the Annaba city. For a better management of solid waste treatment, the city of Annaba is subdivided into 5 different sectors (Table 2).

Table 2

Sectors of Annaba city (Annaba APC Clean-up Service)

Sectors	*Area*
Sector 1	677.52 ha
Sector 2	702.25 ha
Sector 3	879.70 ha
Sector 4	369.00 ha
Sector 5	453.45 ha

Sector 1. It is the largest in terms of population and tonnage of household solid waste. It is comprised of 9 neighborhoods: Downtown, Old county, county of Caroubier, Port and Avant-Port, County of Patrice Lumumba, County of Center, County of Menadia, County of Annasser and County of Seybouse.

Sector 2. It comprises 8 quarters; County of Oued Eddeheb 1 and 2, County of Didouche Mourad, County May 08 and May 13, County of December 11, 1960, county Ozas, Gazometer.

Sector 3. This sector is characterized by the collective housing, 80% of houses are found in buildings of up to 4 floors and more. This sector includes the County of 1276 logs, County of 687 logs, County 1176 logs, County 1028 logs, Countyof 8 March, County 05 July, County El rym 1 and 2, County of 500 logs and County of Sidi Achour.

Sector 4. It contains the individual and semi-collective housing, indeed 80% of the constructions are villas and buildings of 1 or 2 floors. It encloses the County of Oued Fourcha, County of gas plant, County of la Colonne, County of Zaafrania, County of Eliza, and County of Orangerie

Sector 5. It has the individual and collective housing represented by Oued Kouba 1 and 2, Plaisance, Gasiot, Sidi Aissa, Valmascort, Rizi Amor, Refas Zahouene, Belvedere and Ain Achir.

Socio-demographic context. Industrial growth in the province of Annaba has led to a mass movement of people to the city. This increase in the population has caused the bursting and extension of urbanized areas (Tables 3 and 4).

Table 3

Evolution of the population of Annaba city between 1999 and 2012 (ONS Annaba 2012)

Year	*Population*
1999	540984
2004	557944
2008	609500
2010	625395
2011	631588
2012	637567

Table 4

Distribution of the population of Annaba city by sector (ONS Annaba 2012)

Sectors	*Population*
1	65000
2	55000
3	92000
4	43000
5	28000
Total	283000

Survey prototype. The survey prototype used includes 8 socio-economic data (Table 5), and 354 people have been asked these questions.

Table 5

The survey prototype used for Annaba city

Date……..2015			
1. Personally you feel concerned by the environment			
	Yes	No	
Very concerned Concerned Little or no concern			
2. Ranking of worries			
Climate change Food risks Health Employment Others			
3. Do you think the city of Annaba is clean?			
	Yes	No	
4. What is the waste you observe the most?			
Plastic-bottle bags Glass Metals Wood Textiles - papers Household waste Industrial waste Others			
5. How do you estimate the quality of the removal of macro debris in Annaba?			
Good Moderate Bad Others			
6. Is the number of bins sufficient?			
	Yes	No	
7. Are they well located			
	Yes	No	
8.1. Do you live in Annaba city			
	Yes	No	
8.2. Age			
8.3. Sex	Man	Woman	
8.4. Intellectual level	College	Secondary	University
8.5. Profession			

Results. During this survey we were interested in a set of questions directly related to the wastes of Annaba coastline. This survey covered 8 mainly questions along with some subsequent questions.

Concerning the environment. The results of the survey showed that the majority of the population of the city is interested in the hygiene of its environment. The percentage distribution varies from one station to another. Indeed, the station 8 (Schools) with the three cycles (primary, middle and secondary) is the highest rate of people who feel strongly about the environment (Figure 3) or not concerned are in the corresponding station 7 (La Corniche).

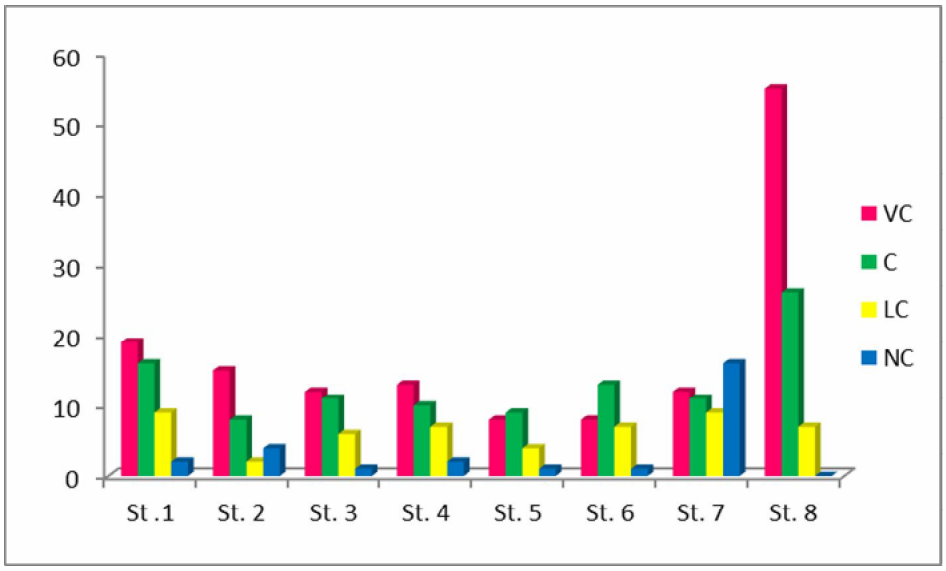

Figure 3. Graphical representation of the responses related to the degrees of interest in the environment per station. Very concerned (VC), concerned (C), little concerned (LC), not concerned (NC). St.1: Sidi Amar, St. 2: SidiA chour, St. 3: El Bouni, St. 4: INESSM, St. 5: Sidi Salem, St. 6: Joinoville, St. 7: Corniche, St. 8: EE: Educational institutions.

The result that seems interesting to us is the rate of people who do not feel concerned (NC) by the state of their environment in Annaba are exceeding the 8.33%. Fortunately the remaining 90.65% are relatively interested to their environment with different degrees: 15.74% feel little concerned (LC), 32.09% concerned (C) and finally 42.82% are very concerned (VC) (Figure 4).

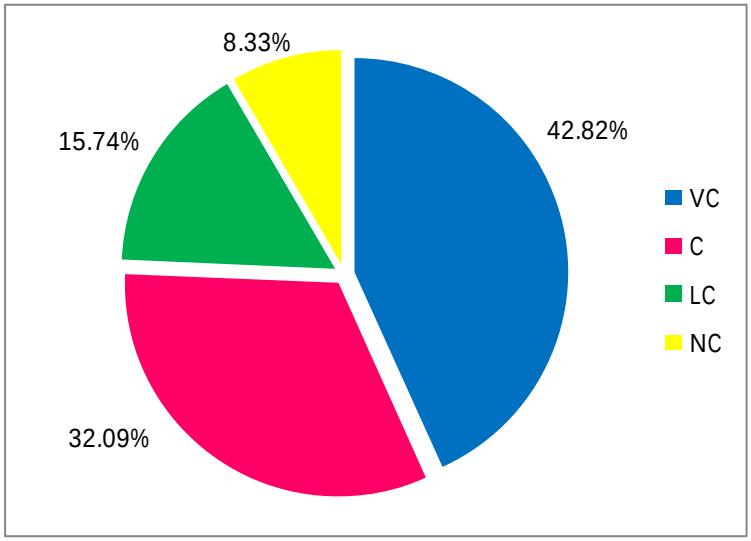

Figure 4. Overall distribution of responses related to environmental interest levels in the city of Annaba. Very concerned (VC), concerned (C), little concerned (LC), not concerned (NC).

Concerning the ranking of the concerns of Annaba population. In this part, 6 types of concerns were ranked according to climate change, water pollution, food risks, health, employment and others.

Regarding climate change. Our results showed that the classification of anxiety "CC" (climate change) varies from one station to another. In station 8, we observed that the majority of people surveyed have classified the CC as their first fear, unlike the stations 1, 2, 3, 4 and 5 which rank the CC in 4th place (Figure 5).

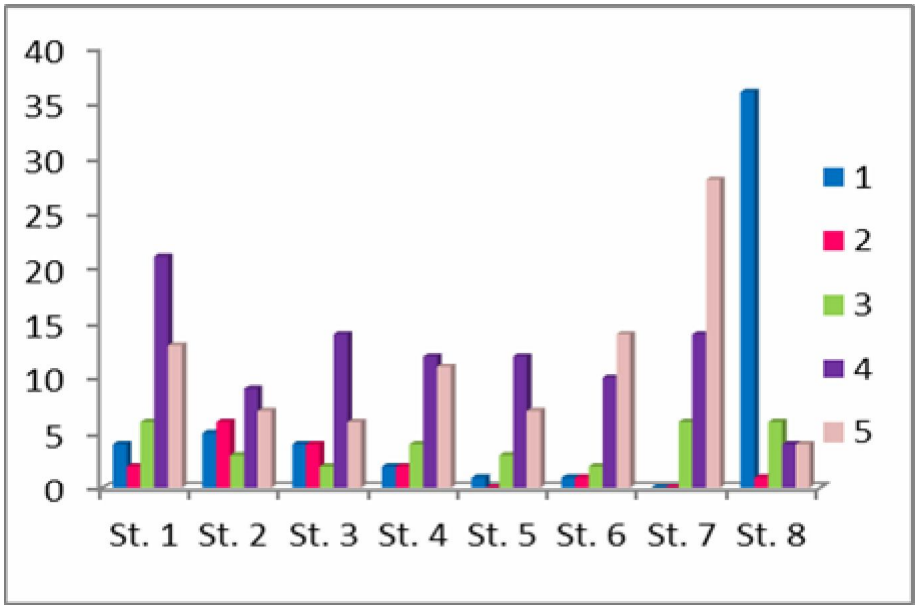

Figure 5. Graphical representation of the "Climate Change" concern ranking responses by station. St.1: Sidi Amar, St.2: Sidi Achour, St. 3: El Bouni, St.4: INESSM, St.5: Sidi Salem, St.6: Joinoville, St.7: Corniche, St. 8: EE: Educational institutions. 1: Climate change "CC", 2: Water pollution "WP", 3: Food risks, 4: Health, 5: Employment.

Figure 6 shows the overall distribution of responses related to the ranking of "CC". 33.44% of people rank the "CC" as 4th concern, 31.35% as 5th and only 18.46% as 1st concern.

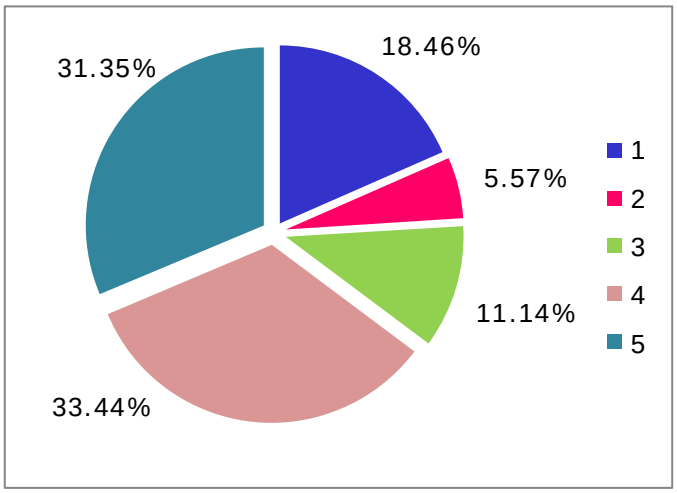

Figure 6. Overall distribution of responses related to the ranking of concern "climate change" in the city of Annaba. 1: Climate change "CC", 2: Water pollution "WP", 3: Food risks, 4: Health, 5: Employment.

Water pollution. Figure 7 shows the rating of worry water pollution "WP" by station. In the stations 1 and 8, the majority subjected to the questionnaire have classified the PE as the 1st concern, while the population of the stations 2 and 3 ranked it as a 2nd concern.

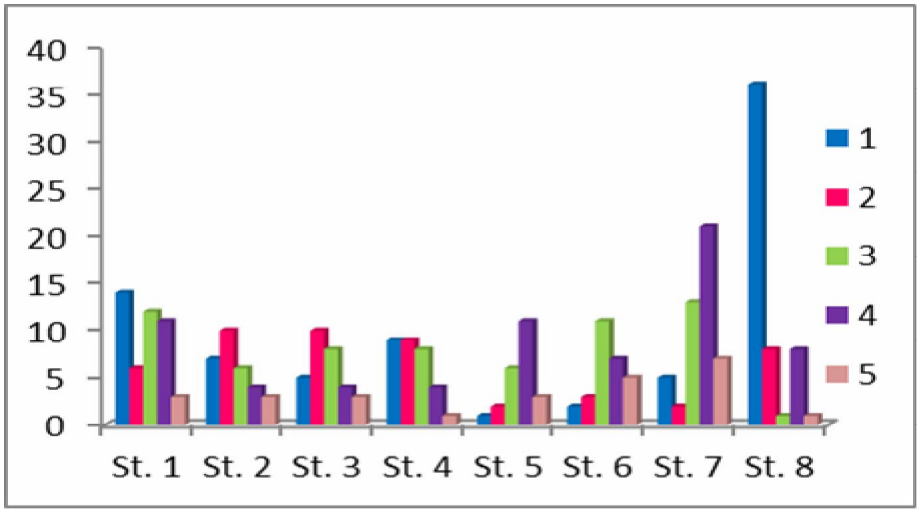

Figure 7. Graphical representation of the responses related to the ranking of concern "Water pollution" by station. St.1: Sidi Amar, St.2: Sidi Achour, St. 3: El Bouni, St.4: INESSM, St.5: Sidi Salem, St.6: Joinoville, St.7: Corniche, St. 8: EE: Educational institutions. 1: Climate change "CC", 2: Water pollution "WP", 3: Food risks, 4: Health, 5: Employment.

Most people classed "WP" as the first concern with a rate of 27.62% and only 9.09% classed it as the last concern (Figure 8).

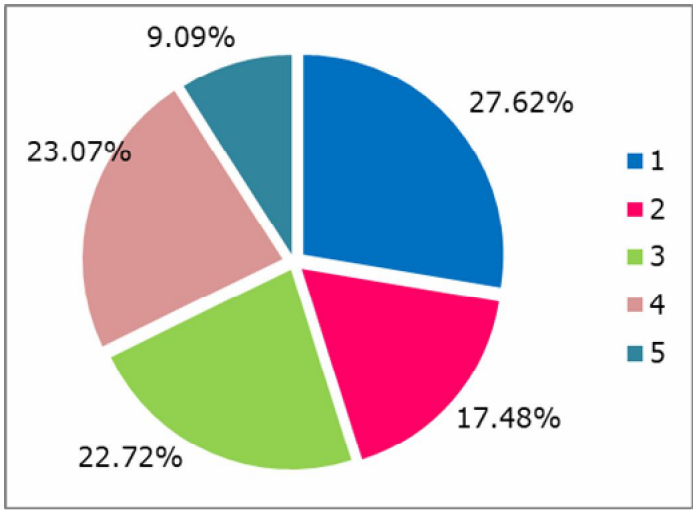

Figure 8. Overall distribution of responses related to the classification of the "water pollution" concern in the city of Annaba. 1: Climate change "CC", 2: Water pollution "WP", 3: Food risks, 4: Health, 5: Employment.

Food risks. With regard to the questionnaire on food risks, our results show that Annaba's educational institutions ranked this issue as the first priority (Figure 9), while in all the resorts, 29.64% classed Food Risks as 1st worry, 27.14% as 2nd, 25.35% in 3rd place, 12.50% in 4th and 5.35% in 5th place (Figure 10).

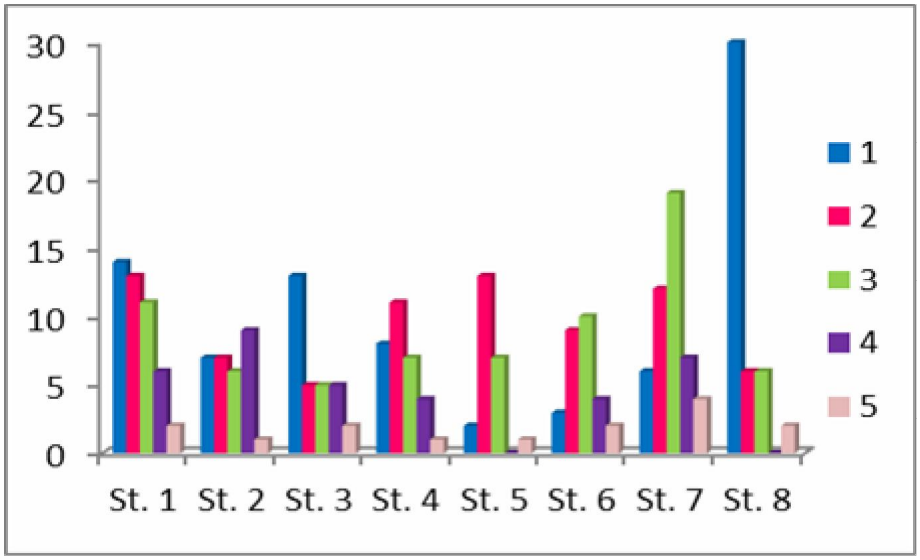

Figure 9. Graphical representation of the responses related to the classification of the Food Risks concern by station. St.1: Sidi Amar, St.2: Sidi Achour, St. 3: El Bouni, St. 4: INESSM, St. 5: Sidi Salem, St.6: Joinoville, St.7: Corniche, St. 8: EE: Educational institutions. 1: Climate change "CC", 2: Water pollution "WP", 3: Food risks, 4: Health, 5: Employment.

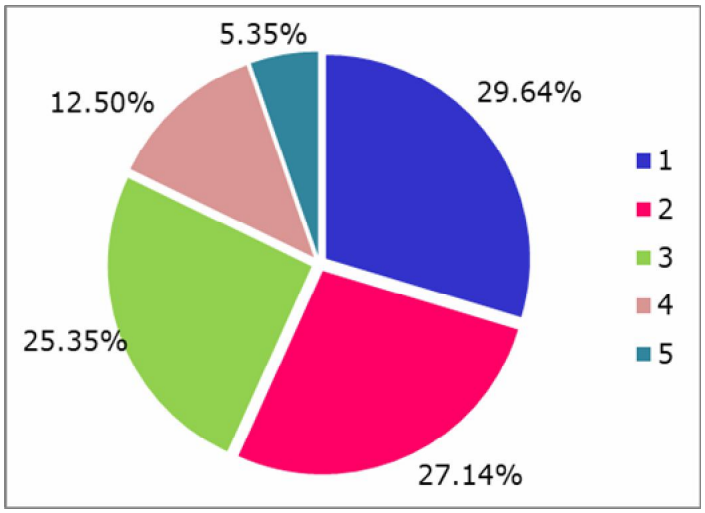

Figure 10. Overall distribution of responses related to the classification of the food risks concern in the city of Annaba. 1: Climate change "CC", 2: Water pollution "WP", 3: Food risks, 4: Health, 5: Employment.

Health. Figure 11 shows the responses related to the ranking of "health" by station. Our results showed that most people of stations 4, 5, 6 and 8 were submitted to the health as the first concern, while stations 1, 3 and 7 ranked it as 2nd and finally in the station 2 health is considered as 3rd priority. Thus, more than 50.16% of people surveyed have classified health as the first concern, 26.26% as the second and only 2.02% as the fifth concern (Figure 12).

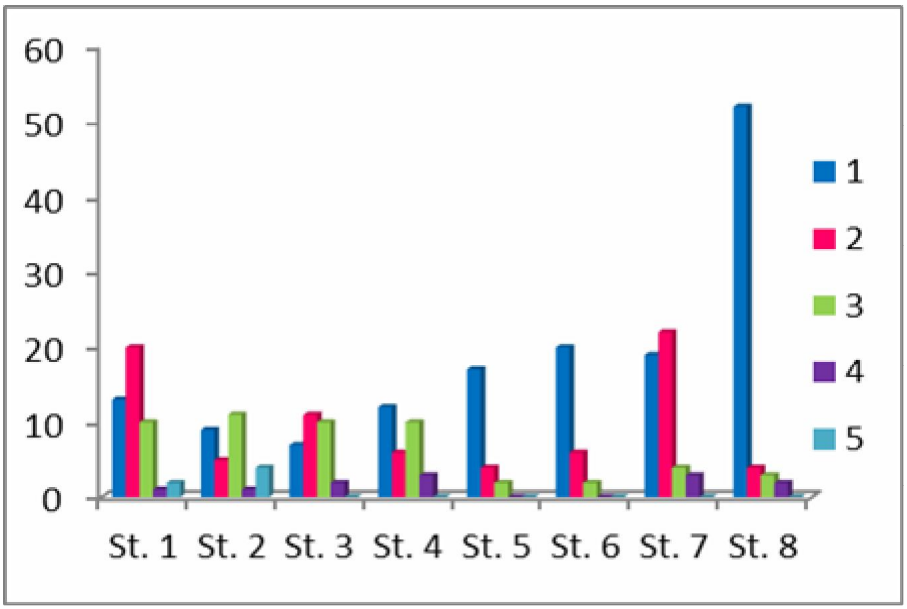

Figure 11. Graphical representation of the responses related to the ranking of health concerns by station. St.1: Sidi Ammar, St.2: Sidi Achour, St. 3: El Bouni, St.4: INESSM, St.5: Sidi Salem, St.6: Joinoville, St.7: Corniche, St. 8: Educational institutions. 1: Climate change "CC", 2: Water pollution "WP", 3: Food risks, 4: Health, 5: Employment.

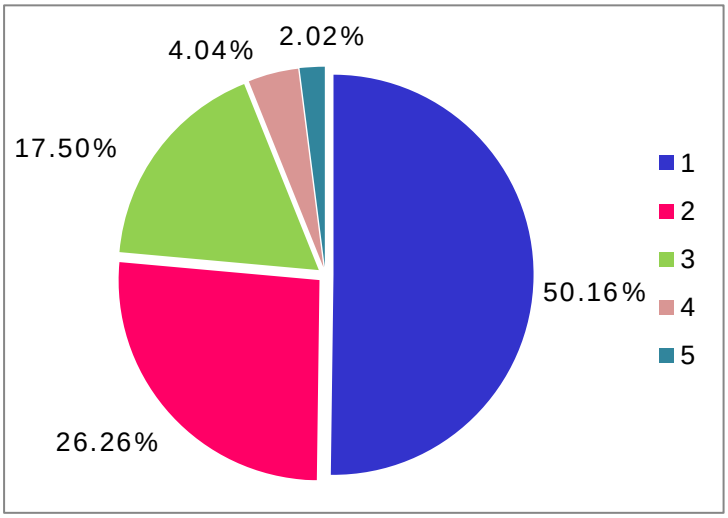

Figure 12. Overall distribution of responses related to the classification of the "health" concern in the city of Annaba. 1: Climate change "CC", 2: Water pollution "WP", 3: Food risks, 4: Health, 5: Employment.

Employment. Figure 13 shows that in stations 1, 2, 3, 4, 5 and 8, the majority of people ranked the job in the 5th place, while station 7 is considered as the 1st, followed by station 6 where it is 2nd. We observed 12.09, 13.70, 12.90, 15.32 and 45.96%, respectively as 1st, 2nd, 3rd, 4th and 5th (Figure 14).

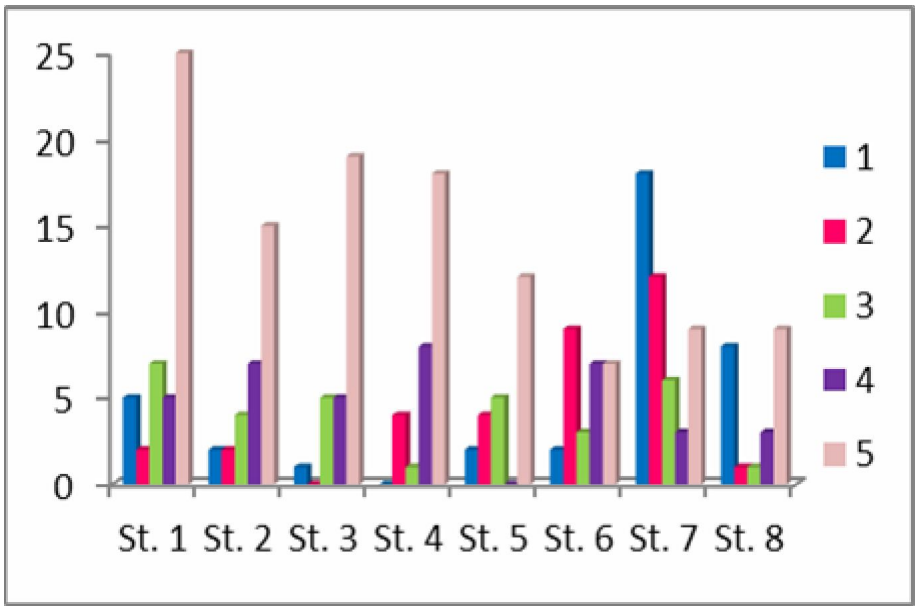

Figure 13. Graphical representation of the responses related to the classification of the "Employment" concern by station. St.1: Sidi Ammar, St.2: Sidi Achour, St. 3: El Bouni, St.4: INESSM, St.5: Sidi Salem, St.6: Joinoville, St. 7: Corniche, St. 8: Educational institutions. 1: Climate change "CC", 2: Water pollution "WP", 3: Food risks, 4: Health, 5: Employment.

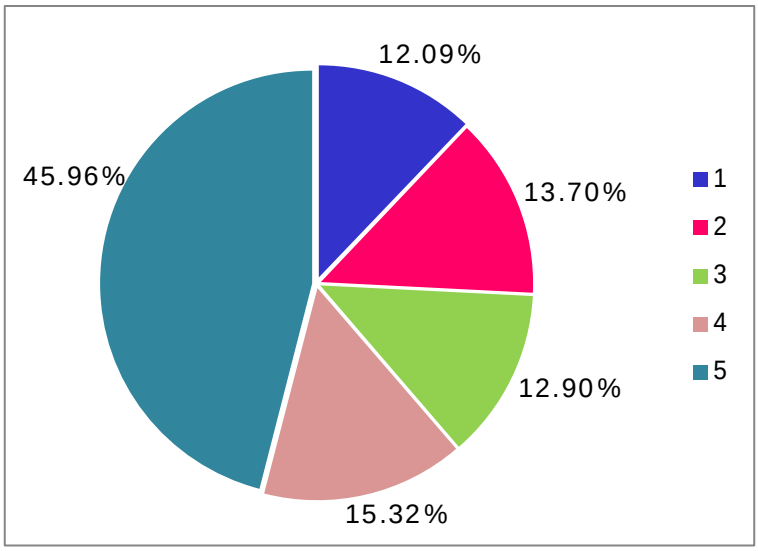

Figure 14. Overall distribution of responses related to the ranking of the "Employment" concern in the city of Annaba. 1: Climate change "CC", 2: Water pollution "WP", 3: Food risks, 4: Health, 5: Employment.

Other concerns. Our results show that for the question 'other concerns', the population of the stations 3, 5 and 6 have a value of zero, whereas it reaches respectively 27.27% in the station 1, 24.24% in the station 2, 6.06% in the station 4, 3.03% in the station 7 and 39.39% in the station 8 (Figures 15 and 16).

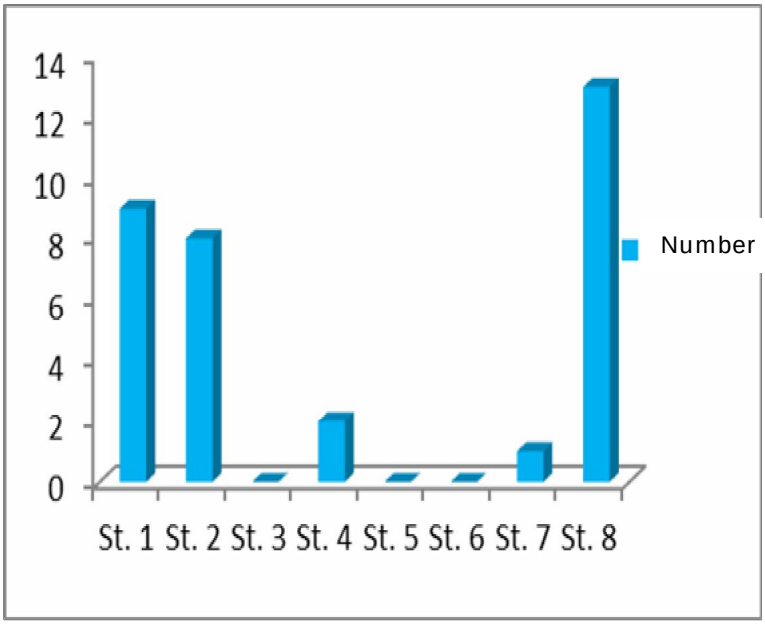

Figure 15. Graphical representation of the responses related to the ranking of other worries by station. St.1: Sidi Amar, St.2: Sidi Achour, St. 3: El Bouni, St.4: INESSM, St.5: Sidi Salem, St.6: Joinoville, St.7: Corniche, St. 8: EE teaching institutions. (St.3, St.5 and St.6 = 0%).

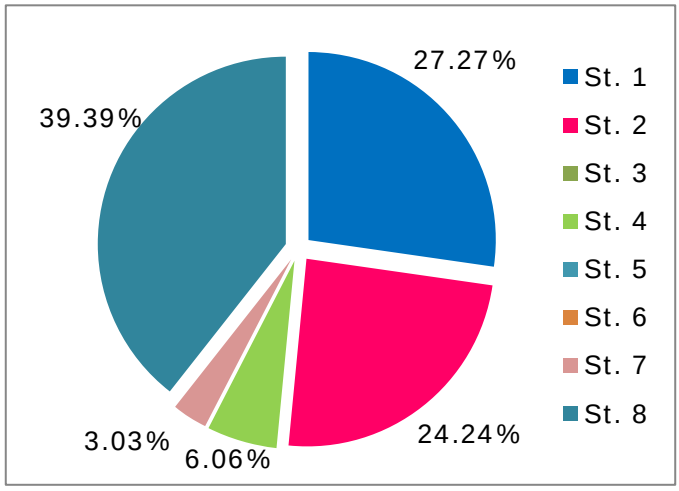

Figure 16. Overall Distribution of Responses Related to the Ranking of Other Concerns Employment in the city of Annaba (St. 3, St. 5 and St. 6 = 0%).

Regarding the degree of cleanliness of Annaba city. The purpose of the question is: 'do you think that the city of Annaba is clean', is to know the degree of cleanliness of the city. The results of our survey showed that 85.13% of the surveyed believe that the city of Annaba is unhealthy and this practically in all the eight study stations (Figures 17 and 18).

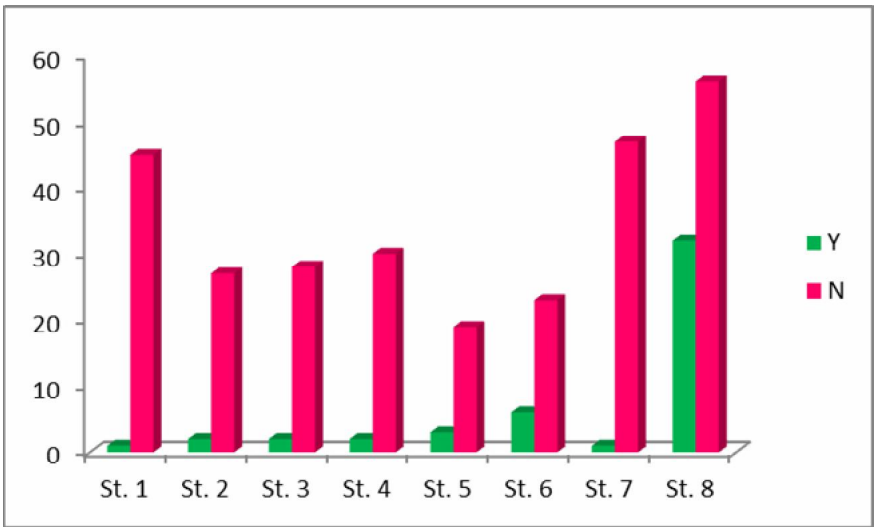

Figure 17. Graphical representation of responses related to the city's degree of cleanliness by station. St. 1: Sidi Amar, St. 2: SidiAchour, St. 3: El Bouni, St. 4: INESSM, St. 5: Sidi Salem, St. 6: Joinoville, St. 7: Corniche, St. 8: Educational institutions. Yes: Y, No: N.

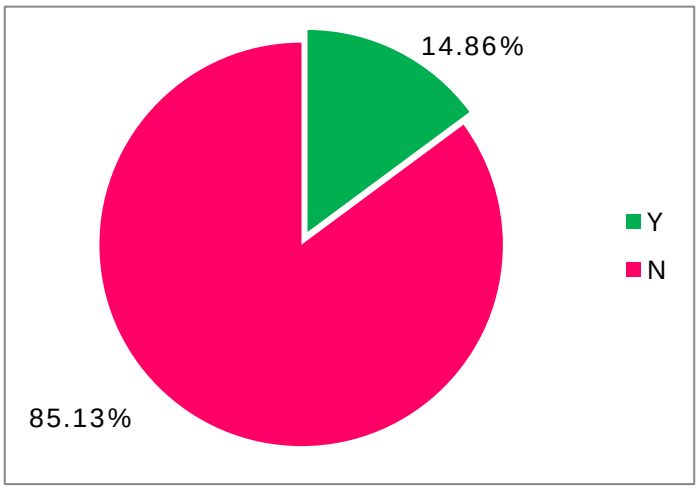

Figure 18. Overall distribution of responses related to degrees of cleanliness of Annaba city. Yes: Y, No: N.

Regarding the most observed waste. To this question, our results of the classification of the most observed waste in the 8 stations of Annaba city ranged from 37.38, 13.36, 11.71, 11.35, 10.67, 8.65, 5.32 and 1.12%, respectively for plastics, industries, glasses, metal, household, wood, textiles/paper and other wastes (Figures 19 and 20).

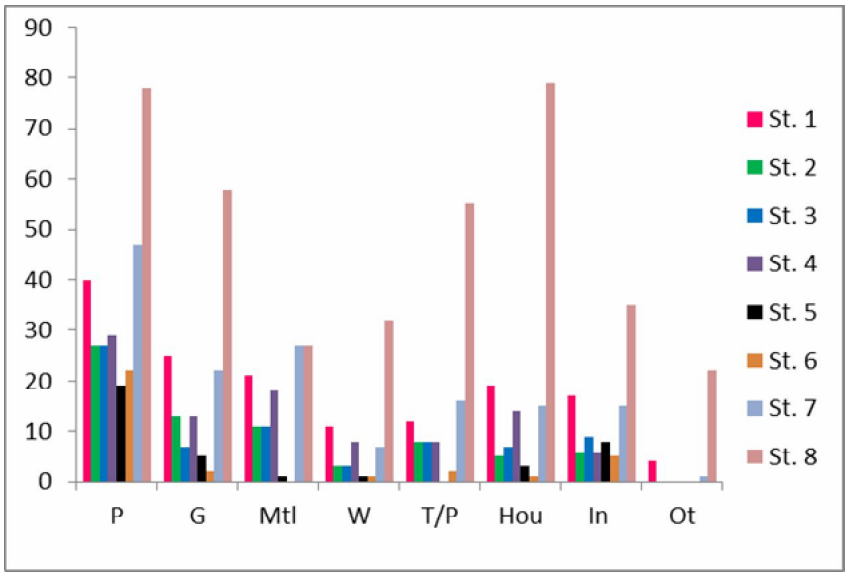

Figure 19. Graphical representation of the responses related to the most observed levels of waste by station. St. 1: Sidi Amar, St. 2: Sidi Achour, St. 3: El Bouni, St. 4: INESSM, St. 5: Sidi Salem, St. 6: Joinoville, St. 7: Corniche, St. 8: Educational institutions. P: plastics, G: glass, Mtl: metal, W: wood, T/P: textile/paper, Hou: household, In: industrial, Ot: other.

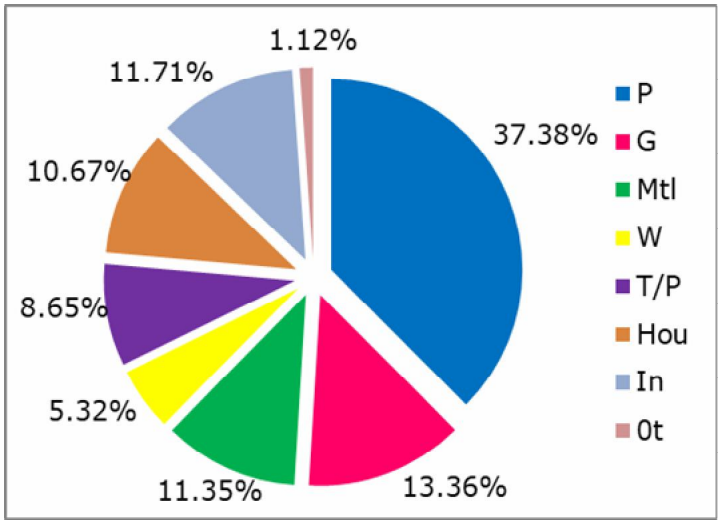

Figure 20. Overall distribution of responses related to the most observed degree of waste in the city of Annaba. P: Plastics, G: Glass, Mtl: Metal, W: Wood, T / P: Textile / Paper, Hou: Household, In: Industrial, Ot: Other.

Regarding the effectiveness of waste removal in Annaba. Figure 21 shows the degree of quality of the removal of macro-waste by station. It is observed that in the stations 1, 4 and 8 the majority of people consider that the quality of removal is average. On the other hand, stations 3, 6, and 7 are considered bad and in stations 2 and 5 the quality is either average or bad. Indeed, 45.12% of the population of Annaba thinks that the quality of macro-waste removal is poor (Figure 22).

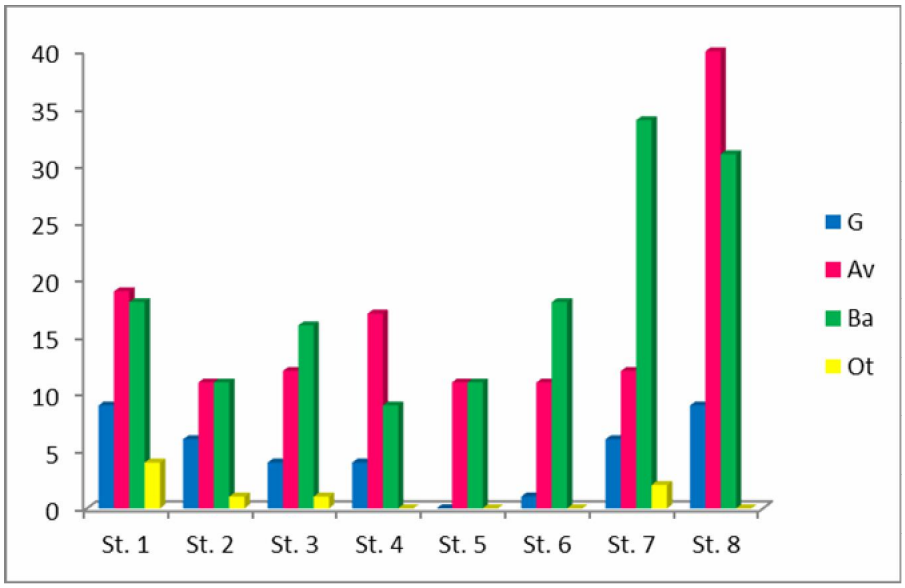

Figure 21. Graphical representation of the responses related to degrees of quality of removal of waste by station. St. 1: Sidi Ammar, St. 2: Sidi Achour, St. 3: El Bouni, St. 4: INESSM, St. 5: Sidi Salem, St. 6: Joinoville, St. 7: Corniche, St. 8: Educational institutions; G: good, Av: average, Ba: bad, Ot: other.

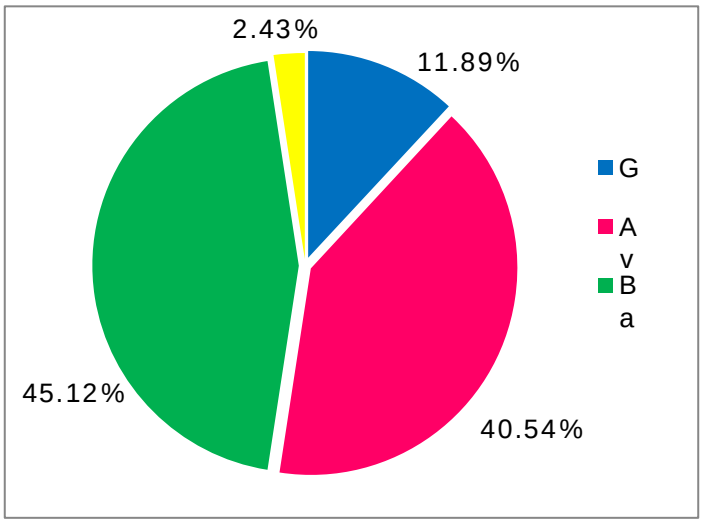

Figure 22. Global distribution of the answers related to the degrees of the quality of the removal of the macro waste in the city of Annaba. G: Good, Av: Average, Ba: Bad, Ot: Other.

Regarding the availability of bins. The question said 'Does the number of bins is sufficient?' 79.83% of the people distributed in the 8 stations of study (Figure 23) think that the number of trash bins in the city of Annaba is insufficient (Figure 24).

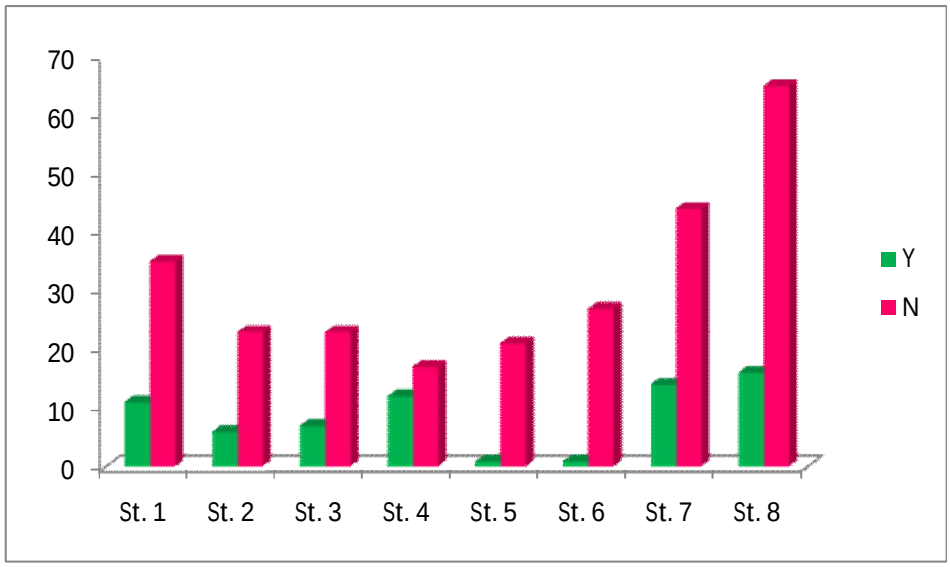

Figure 23. Graphical representation of the responses related to the number of bins per station. St. 1: Sidi Ammar, St. 2: Sidi Achour, St. 3: El Bouni, St. 4: INESSM, St. 5: Sidi Salem, St. 6: Joinoville, St. 7: Corniche, St. 8: Educational institutions, Yes: Y, No: N.

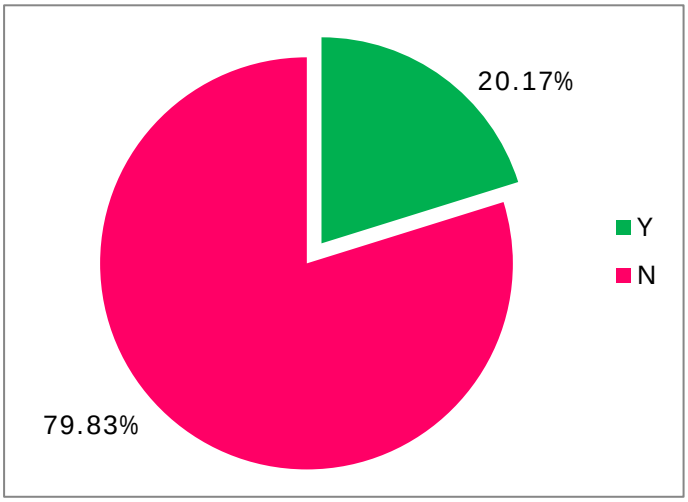

Figure 24. Overall distribution of responses related to the most observed degree of waste in the city of Annaba. Yes: Y, No: N.

Concerning the disposition of the bins in the city of Annaba. To the question 'is Annaba's dustbins well located?' our results showed that 80.51% of the responses are negative regardless of the station (Figures 25 and 26).

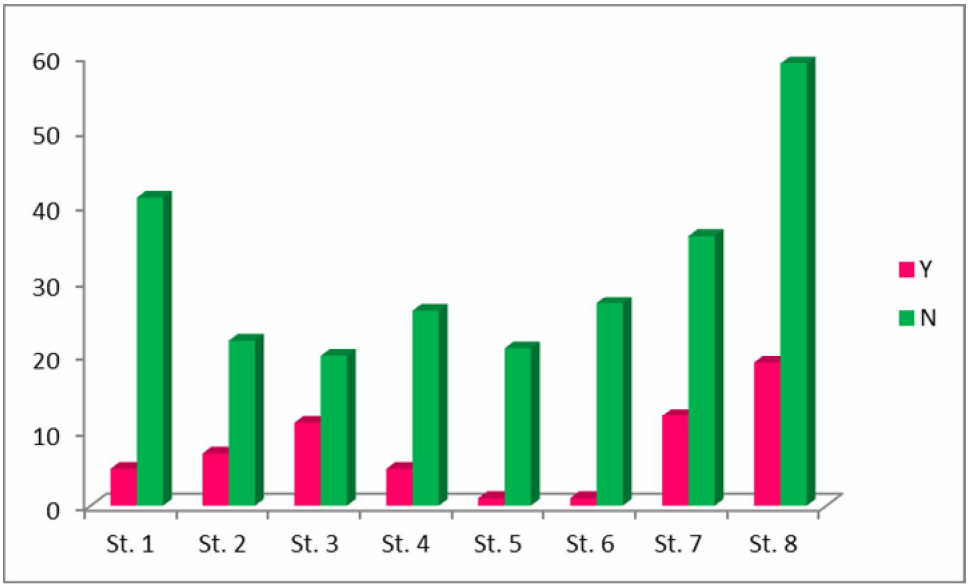

Figure 25. Graphical representation of the answers related to the degree of the situation of the bins by station. St. 1: Sidi Ammar, St. 2: Sidi Achour, St. 3: El Bouni, St. 4: INESSM, St. 5: Sidi Salem, St. 6: Joinoville, St. 7: Corniche, St. 8: Educational institutions, Yes: Y, No: N.

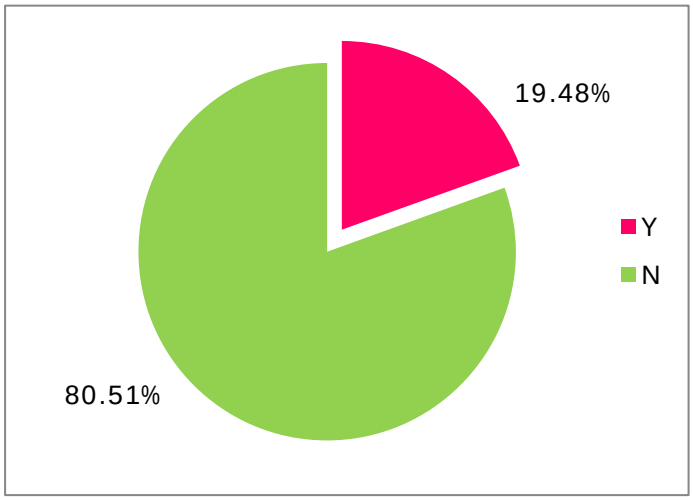

Figure 26. Overall distribution of responses related to the degree of the situation of garbage in the city of Annaba. Yes: Y, No: N.

Concerning individuals questioned

Regarding their residence. Figures 27 and 28 show that almost the entire population responding to the questionnaire resides in Annaba, with a percentage of 86.70%.

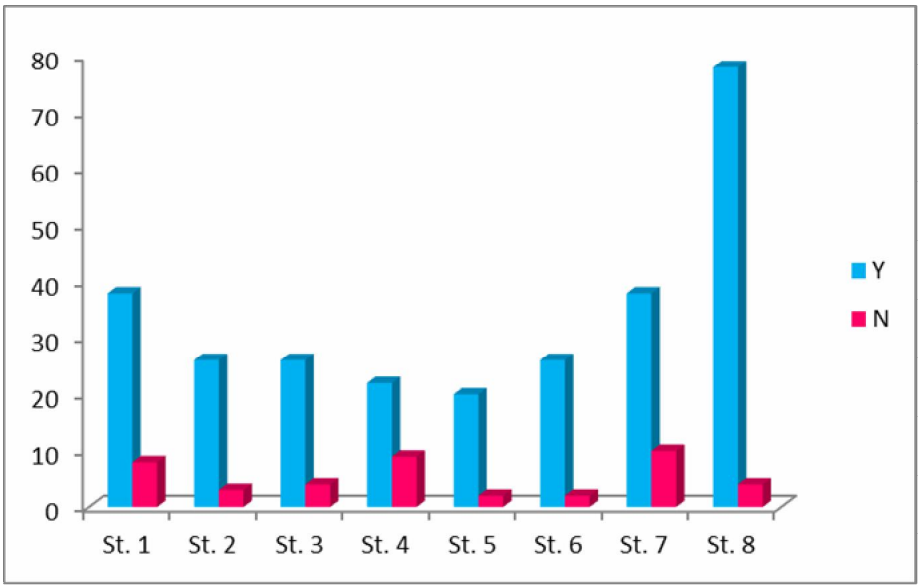

Figure 27. Graphical representation of the responses related to the degrees of population housing per station. St. 1: Sidi Ammar, St. 2: Sidi Achour, St. 3: El Bouni, St. 4: INESSM, St. 5: Sidi Salem, St. 6: Joinoville, St. 7: Corniche, St. 8: Educational institutions, Yes: Y, No: N.

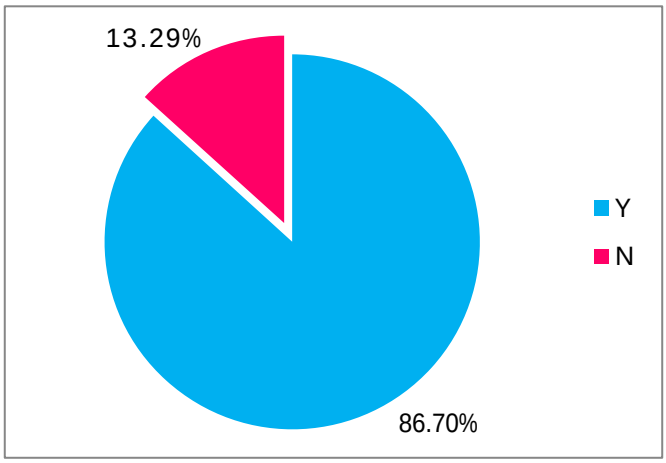

Figure 28. Overall distribution of responses related to the degrees of population housing in the city of Annaba. Yes: Y, No: N.

Regarding their ages. In a sociological study, it is important to take the opinion of people of different age groups in the population. The results of our survey showed that people aging between 21 and 35 years representing 48.58% are most present in stations 1, 2, 3, 4, 5 and 6, while people between 36 and 60+ years with 27.76% are the most present in the station 7. Finally, in the station 8, the population aged from 10 to 20 years represented 23.65% (Figures 29 and 30).

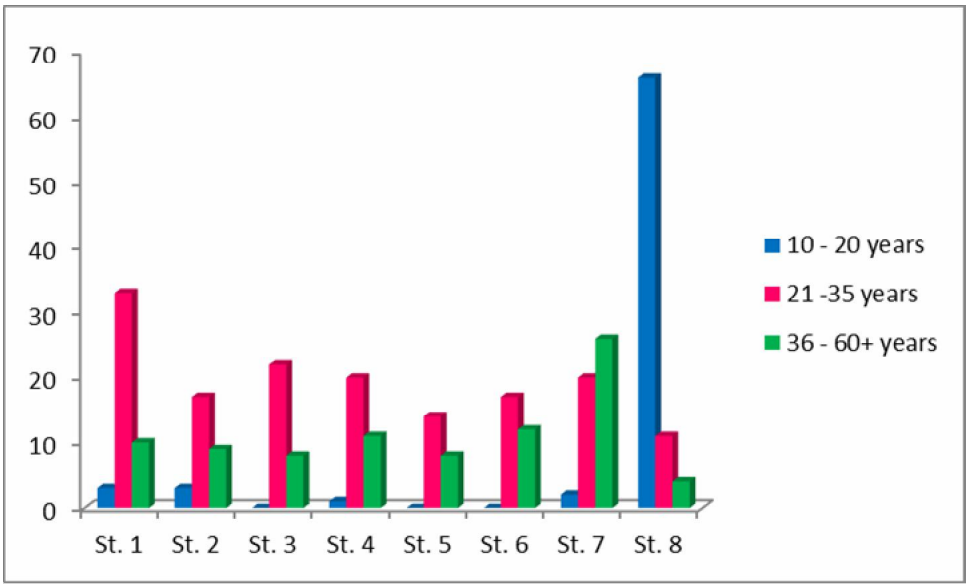

Figure 29. Graphical representation of the responses related to the distribution of respondents by age group by station. St. 1: Sidi Ammar, St. 2: Sidi Achour, St. 3: El Bouni, St. 4: INESSM, St. 5: Sidi Salem, St. 6: Joinoville, St. 7: Corniche, St. 8: Educational institutions.

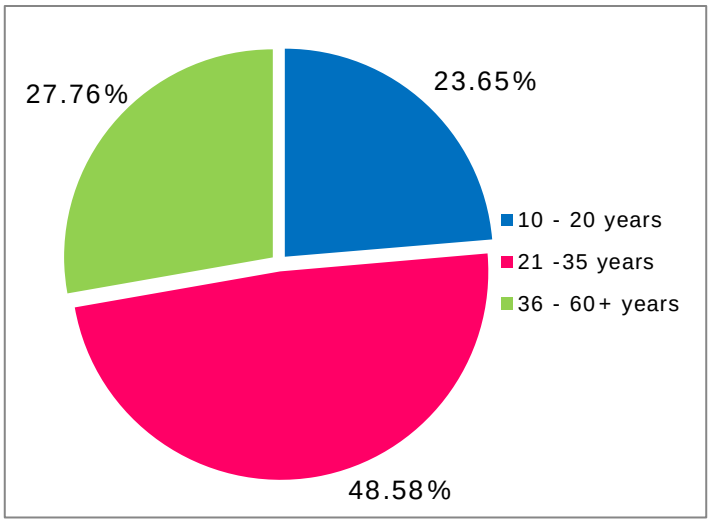

Figure 30. Overall distribution of responses related to the distribution of respondents by age group in the city of Annaba.

Regarding their genders. Figure 31 shows the distribution of the results of the sex-ratio section by station. In stations 1, 2, 3, 4, 5, 6 and 7 men are the most present compared to women, unlike station 8. Overall, men represent 59.62% and women 40.37% (Figure 32).

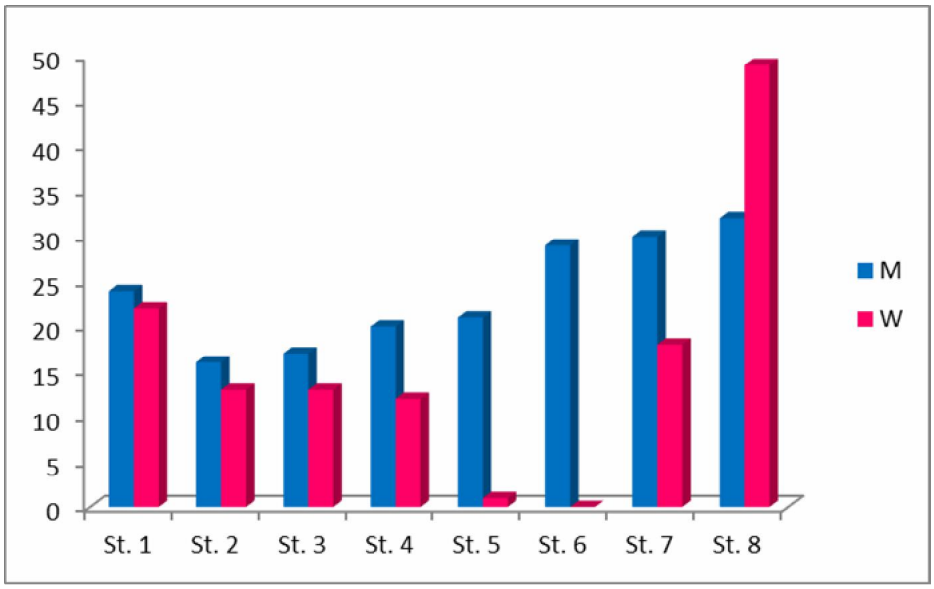

Figure 31. Graphical representation of the responses related to the distribution of the results of the sex ratio section by station. St. 1: Sidi Ammar, St. 2: Sidi Achour, St. 3: El Bouni, St. 4: INESSM, St. 5: Sidi Salem, St. 6: Joinoville, St. 7: Corniche, St. 8: Educational institutions, Men: M, Women: W.

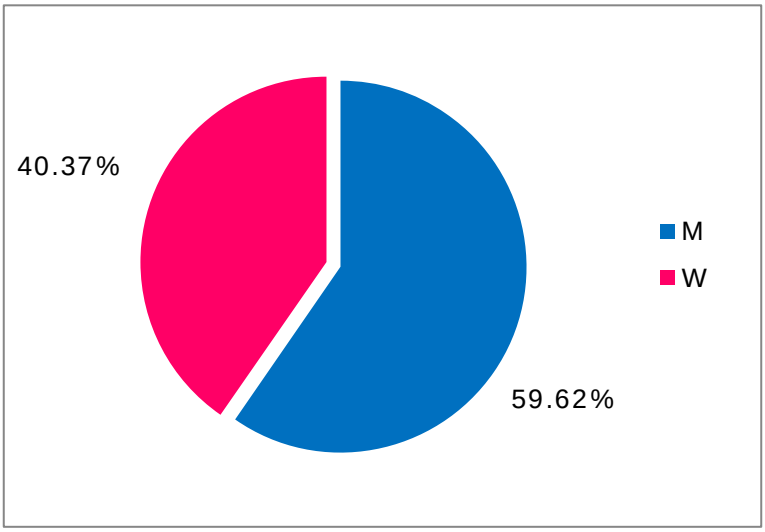

Figure 32. Overall distribution of responses related to the distribution of respondents by the sex-ratio section of Annaba city. Men: M, Women: W.

Concerning the intellectual level. Figure 33 represents the intellectual level of the people surveyed by station. In stations 1, 2, 3, 4, 5 and 6, the university level (U) is higher compared to others, whereas in stations 7 and 8 the secondary level (S) is dominant. From the overall point of view, our results show that the respective intellectual levels of Annaba city are 58.86% U, 24.68% S and 16.45% M (Figure 34).

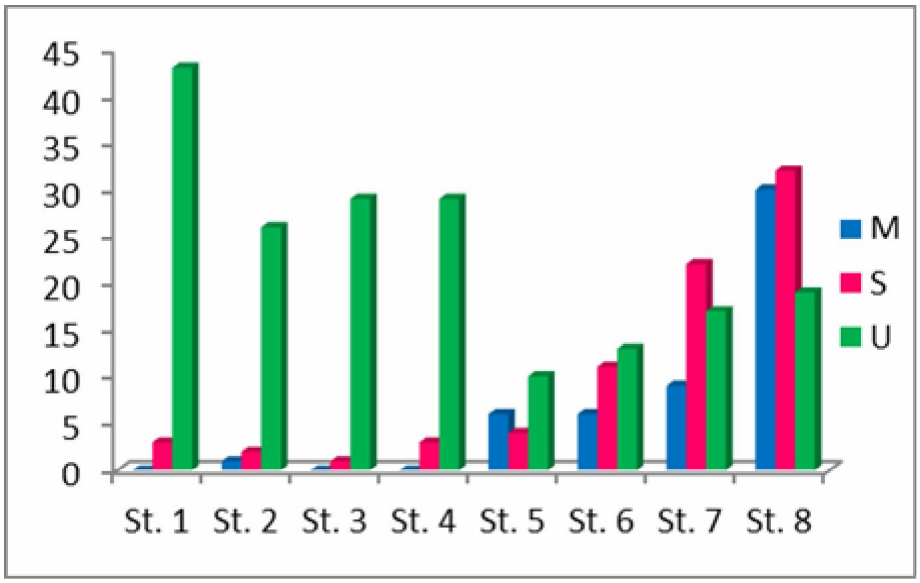

Figure 33. Graphical representation of the answers related to the degrees of intellectual level by station. St. 1: Sidi Ammar, St. 2: Sidi Achour, St. 3: El Bouni, St. 4: INESSM, St. 5: Sidi Salem, St. 6: Joinoville, St. 7: Corniche, St. 8: Educational institutions, M: Medium, S: Secondary, U: University.

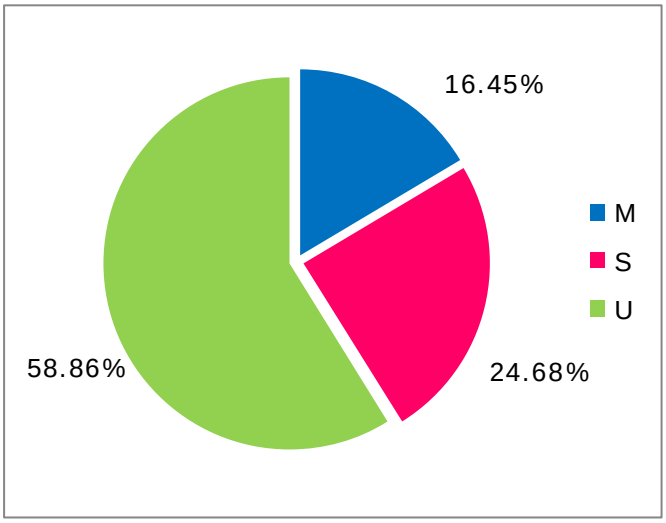

Figure 34. Global distribution of the answers related to the degrees of intellectual level in the city of Annaba. M: Medium, S: Secondary, U: University.

Regarding their professions. The objective sought to know the profession of the population questioned. Our results show that the most prevalent occupation in the stations 1, 2, 3, 4 and 8 are Student/student/PhD student (S/S/PhD) with 52.66%, followed by the teachers with 10.88%, the liberal professions with 11.04% (Figures 35 and 36).

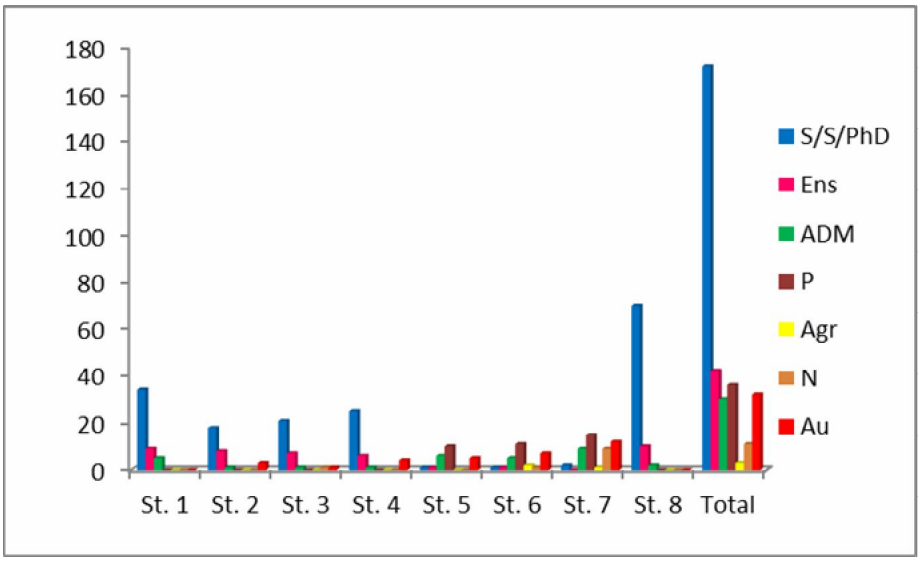

Figure 35. Graphical representation of the answers related to the distributions of the persons surveyed by socio-professional categories by station. St.1: SidiAmmar, St.2: SidiAchour, St. 3: El Bouni, St.4: INESSM, St.5: Sidi Salem, St.6: Joinoville, St.7: Corniche, St.8: Educational institutions, Student / Student / PhD student: S/S/PhD, Te: Teacher, ADM: Administration, P: Private, Agr: Agriculture, N: None, Ot: Other.

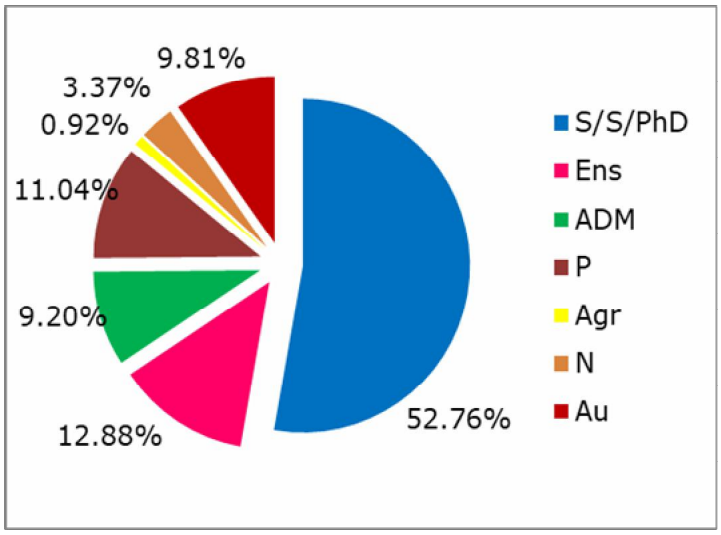

Figure 36. Overall distribution of responses related to the distribution of respondents by socio-professional categories in the city of Annaba. Pupil/Student/PhD student: E/E/D, Te: teacher, ADM: administration, P: private, Agr: agriculture, N: none, Ot: others.

Discussion. The city of Annaba has more than twenty uncontrolled dumpsites where more than 700 tons of solid waste are dumped daily, including 350 from the municipality of Annaba alone. The latter is one of the cities most affected by pollution in Algeria with its wild dumps in Boukhmira, Bousedra (community of El Bouni), Sidi Brahim, Rym (community of Annaba) and El Hadjar.

The problem of the cleanliness operation services has many concerns regarding garbage evacuation outside the districts. Nevertheless, it is the methods of valorization that can guide to resolve the problems of waste evacuation (Chaouch & Djebar 2006).

Annaba's household waste consists mainly of putrescible waste with a 46% share. Textiles, plastics, papers and cardboard fractions represent respectively 15.1, 10.01 and 5%, while fine particles represent 12% (Cheniti 2014).

Rapid population growth, pollution and a disturbing tourist influx in the summer threaten the fauna and flora of Annaba Bay. Releases of solid waste on its beaches are a plague that degrades the beauty of its landscapes. Chaouch (2007) showed that plastics in Annaba represent the largest waste with 29%, metals with 23%, glass with 22%, wood with 15% and finally papers and textiles with respectively 6 and 5%.

Our results are comparable to those of Chaouch (2007), where we noted a predominance of plastics that reach 37.38%, followed by glass with 13.36%, unlike other industrial wastes, metals, households, textiles/papers, which constitute respectively, 11.71, 11.35, 10.67, 8.65 and 5.32%.

The results of our investigation led to the following observations:

- most of the population of Annaba city is concerned with hygiene and the environment;
- the collection of waste is not done regularly and does not respect schedules;
- the rotations of waste collection are carried out at the rate of one rotation / 2 days in the peripheral cities of Annaba, while in the city center, it is done daily;
- the maintenance and use of the bins are not well respected by the citizens as well as the cleaning service;
- insufficient number of rotating street sweeping and public places (once during the summer season and once during the year);
- the difference between sectors in terms of quantity and composition of waste;
- the number of bins is insufficient and they are badly located;
- the difficulties of collecting wastes in the district of the old town (La Place d'armes);
- the lack of a specific collection service for non-household waste (rubble, bulky waste, anatomical waste) which caused the presence of black spots in the city;
- insufficient systems for eliminating macro-waste (plastics, glasses, bios, household goods, etc.);
- almost no processing units for recyclable waste (glass, plastic, paper, etc.);
- absence of impact study of solid household waste on health and the environment;
- contamination of groundwater near the Berkazerka dumpsite;
- according to the standards advocated by WHO (2010), the groundwater of the region will become short-term unfit for consumption;
- lack of means of protection for the dump workers;
- the absence of household waste sorting;
- the severity of the activity of the cleaning agents, which exposes them to occupational accidents and sometimes serious occupational diseases;
- the follow-up operations of the household waste management by the cleaning service revealed the existence of three problems that can be summarized up in:

1. the waste collection budget is in direct contact with the public treasury, and the low tax collection rate of waste removal;
2. the municipality is still unable to meet all the expenses generated by the activities of household waste management, collection and transport;
3. the lack of human capacity, of the public sector (training of specialists, number of qualified personnel, empowerment of managers and continuous training).

These 3 points hamper the good functioning of the service, especially in the matter of purchase of spare parts, recruitment, etc.

In terms of solid household waste management in the municipality of Annaba, the collection and treatment facilities available in local communities are very limited and sometimes inadequate, leading to the emergence of various cases of diseases and visual pollution. The choice of certain landfills has been to the detriment of the environmental framework, especially in the absence of impact studies.

Conclusions. We can say that the management of macrowastes is a very complex operation and its success depends on the civic behavior on the part of the citizens and the mobilization of important human, technical and financial means of the municipality. The production of macro wastes: plastic, glass, household, etc. is steadily increasing and is directly related to population growth and economic growth.

It is proven that wastes have an impact on the health of populations by the proliferation of insects and the persistence of diseases such as hepatitis, pneumopathies, dermatitis, etc. Plastics and household wastes cause an environmental pollution, particularly soil, air, coast and surface and underground water.

It is essential to set up an integrated management of these wastes through collective and individual prevention measures indeed, the proliferation of household waste falls into 5 points: bad management; insufficient infrastructure and drainage equipment; the collection and treatment of household waste; the low rate of people joining the benefits; neglectfulness and traditional habits of household waste management of part of the population.

The municipality of Annaba needs to improve continually the conditions of disposal and collection of wastes. The municipality must also ensure the preservation of public hygiene and the cleanliness of agglomerations. Thus, our investigation directs us towards the principle of waste management; Reduce, Reuse, and Recycle.

References

Algerian demography, 2015. N°740, pp. 3.

APC (Communal People's Assembly) Annaba, 2014 Documentation, pp. 12-34.

Annaba Cleaning Service APC, 2012 Documentation.

Brunet R., 2010 Treatment and management of household waste at the meeting: geographical approach. PhD Thesis, Geography, University of Réunion, France.

Chaouch R., 2007 Identification and quantification of solid wastes encumbering the beaches of the city of Annaba: physicochemical and bacteriological aspects of the waters. Memory of Magister University BadjiMokhtar-Annaba, Algeria, pp. 41-65.

Chaouch R., Djebar A. B., 2006 Identification and quantification of solid wastes encumbering the beaches of the Annaba coast. Communication of the 1st Mediterranean Conference of Oceanology, Algiers, 20-22 November.

Cheniti H., 2014 Urban solid waste management: the case of the city of Annaba. PhD thesis, BadjiMokhtar University - Annaba, Algeria, pp. 96-118.

DUC, 2012 Annaba Planning and Construction Department. Survey results, 2012, pp. 12-25.

Gallini P., 2008 The Mediterranean threatened by pollution. Provence press.

Gareau P., 2001 No risks to take. Residual materials management and risks to human health. Montreal, Quebec: Quebec Common Front for Ecological Waste Management, pp. 17-18.

Hammoudi K., 2014 Rapport 2014 de l'organisation mondiale du tourisme: L'Algérie, 4e pays le plus visité en Afrique en 2013. Available at: http://www.lemidi-dz.com/index.php?operation=voir_article&id_article=evenement%40art4%402014-10-13. Accessed: December, 2017.

INVS, 2004 Institute for Public Health Surveillance, Waste storage and public health. Summary and recommendations, 40 pp.

Kacemi M., 2006 Protection of the littoral in Algeria policies and local authorities. Vertigo - the Journal in Environmental Sciences 7(3):1-9.

MeHSIP, 2008 Elaboration of a Mediterranean Hot Spot Investment Program. Final report for contract reg/2006/02 fwceuropeaid/119860/c/sv/multi lot No. 2: transport and infrastructure; horizon 2020.

ONS, 2012 National Statistical Office Annaba. Results of surveys 2012.

Saline Station Annaba, 2012 Results from research and surveys.

WHO, 2010 World Health Organization. 2010 survey results.

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