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KEY FACTOR OF ENVIRONMENTAL POLLUTION OF THE DOMESTIC SOLID WASTE IN THE CITY OF DERNA, LIBYA

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ABSTRACT

The study aims to identify the most important reasons that led to the aggravation of the problem, the resulted consequences and the methods used in the city to dispose it. A minimum sample of 370 families was used and distributed for them questionnaire using the Stratified Relatively Sample. Chi Square was employed to analyze the statistical data and converted them into tables, percentages and graphics. The environmental awareness of citizens and methods of getting rid of the domestic garbage are playing an effective role in limiting the size of the resulting garbage problem. Where, 41.1% of the families save the garbage in plastic bags, and this is Ineffective way, and 39% of them do not commit to the specific times of removing the garbage. The apparent lacks of mechanisms, equipments and labors used in the process of cleaning in the Environment Protection Agency have led to the increase of the problem in the city. This is resulted from the lack of financial resources. Besides that, 41.6% of residents throw the waste in open places, and remain stacked for long periods in the streets and open areas in the city. Even after the process of the collection it gets disposed in an open dunghill within the border of the city and is sometimes burned, which would generate the spread of odors and distort the environmental view and standards as well as the proliferation of stranded roaming animals, rodents and insects which causes and transfers diseases.

Keywords: Derna, Environmental, Domestic, Solid waste, Diseases, Garbage

INTRODUCTION

The environmental pollution is considered to be the issue of today; since it affects human health, and the environment is also the issue of tomorrow; since it affects the natural resources. For that, paying attention to the environmental issues is not a luxury task limited to the maintenance of natural beauty and its purity, but it is related to the human's survival, health and his resources production, it is also related to human's responsibilities towards future generations (Almabrook 2003).

The solid waste contributes significantly to the problems of the environmental pollution in urban areas. The way of living in the urban with its known characteristics has necessitated and increased the trends towards packaging products in containers that are easy to dispose, and this is considered as a solid garbage after their disposal, despite their innocent existence as a mean of protecting human's health, the residents have increased their attitude towards the use of these cans, packages and tins of various kinds, while the available resources are incapable of disposing it. A report from the Environmental Awareness Board in the United States of America has discovered that only 23% of this garbage is disposed in healthy ways and 77% is disposed in open area surrounding cities (Nofel 1996).

Domestic solid waste is the most important type of the garbage, its huge amount in the daily produced garbage of the city, it is very dangerous because it is produced from all the houses, restaurants and shops in the city, it represents about 85% of the total solid garbage produced in a day. For example, the city of Cairo produces daily 4500 tons of garbage, 3825 tons of this garbage is domestic garbage (Eid 1993). Domestic garbage solid generates a serious

environmental problems in the all countries of the world, that is due to the ease of accumulation and since it is a good place for the insects and microbes which cause diseases and the proliferation of roaming animals, rodents which causes consequent harassment for people, because of the foul smells and the distort of the overall view of the city (Almataz 1988).

This study deals with a geographical analysis of the problem of pollution resulted from the domestic solid waste in the city of Derna. The aims to identify the most important reasons that led to the aggravation of the problem, the resulted consequences and the methods used in the city to dispose it and to highlight on the amount of garbage generated daily in the city.

STUDY AREA

The city of Derna is located in the northeastern part of Libya, in a narrow coastal plain between the sea and the northeastern slopes of the Al-Jabel Al-khdar, and the city is one of the most important urban centers in the Eastern region in terms of population. Also it is location at the sea "Ras Almtarees", where a seaport had been established, this has increased its business, as well as the presence of the most important fisheries of sponges near its shores, which led to increase its economical importance. The total area of Derna city approximately is 762.7 hectares (Habib 1973). Astronomically is located on the latitude 32°45' N, longitude 22°38'E. (Figure 1).

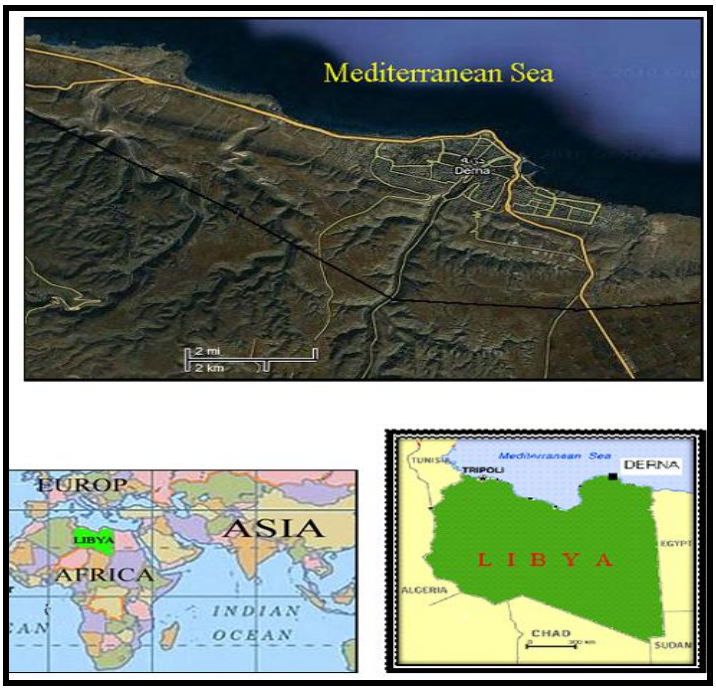


Figure 1: Location of Libya and the study area

METHODOLOGY

The study relied in collect the data by designing a questionnaire containing a series of questions related to the subject of the study and distributing it to a sample of the Darna city population. The study population consists of all the families living in the localities of the Darna (Abu Mansour - AlJubaila - Albilad - Almaghar) and the samples included are 11,798 family. (Census 1995). As for the method through which elements of the samples are selected, it has been dependant on the relative stratified sample, in which we divide the study population into classes, then we select the sample units of each class depending on its size, that is because it

gives more precise estimation better than other samples do, and because the size of each class determines the size of the sample, which means that we take a number of elements that is appropriate with the size of each class, the sample size was 370. (Alsalih and Alsiryani 1979). In this research we have also conducted personal interviews by giving some of the questions to the officials of the Environmental Protection Agency (EPA) in Libya.

After finishing the field study and data collection, we used the qualitative methodology to analyze some of the phenomena related to the subject of study, and for the quantitative data which is difficult to analyze we used the quantitative methodology for analyzing and that is done by transferring it to figures (numbers) distributed in a form of iterations, and percentages, we depended on the Chi Square test (X^2) to find some relationships between the variables of the study and to know which is more influential in the problem of the study.

RESULTS AND DISCUSSION

a. Reasons that led to the growing problem of domestic solid waste in the study area

There are in fact a mutual relationship between environment and people behavior. For example the availability of a certain resources of energy in the environment, decides a certain type of consuming behavior of energy, and this behavior in turn determines the type of pollution that will occur in the environment. In this regard the view of some studies show that most environmental problems -which include the problem of domestic solid waste - is due to the low behavioral patterns the citizen have in dealing with the environment, and since that the citizen is the main producer of such garbage, his behavior is an important axis in the accumulation of these garbage and effective in the process of its disposal and to maintain the level of general cleanness of the environment.

This human behaviors which have impacts on the environment are indicated in urban slums where some housewives throw a he amount of garbage the streets and alleys or in places not assigned to garbage, they sometime entrust children with the task of garbage transfer, and who often throw it next to the container rather than placing it inside. This is happens because of the decline in the behavior of the population due to the low level of the environmental awareness and ignorant of how to deal with solid garbage and disposal practices.

The behavioral factors of citizens are playing a prominent and influential role in determining the size of the problem of garbage generated by the citizen himself, because in the absence of a sense of hygiene as a value of religious, cultural, and social and aesthetic facing a group of behaviors resulting in complicating the problem of garbage and its aggravation (Sadeq 1994). Citizen's behavior and awareness and his role in maintaining cleanliness in the city are determined by the following factors:

i. Means of keeping domestic solid waste inside the house

There are many ways of maintaining garbage in the house before taking it out, theses ways include plastic bags and metal buckets and plastic buckets, peoples are varying in their use of these methods depending on their behavior and their level of environmental awareness. Accordingly, it emerged from the study that 41.1% of the families of the Darna city save the garbage in plastic bags, and this way save garbage and prevent the dispersion and the spread of aromas, but this way may be subject to disruption by certain animals such as cats, while 24.6% of domestic are using covered containers which is considered as one of the best means of saving since it prevents leakage of odors and scatter of the content. The families that

preserve their garbage in open containers reached this ratio 34.3% (Figure 2), and this method is considered as the poorest way to save the garbage, where the contents can be scattered, and leads to spread odors, this method demonstrates the low level of environmental awareness and the lack of attention to hygiene.

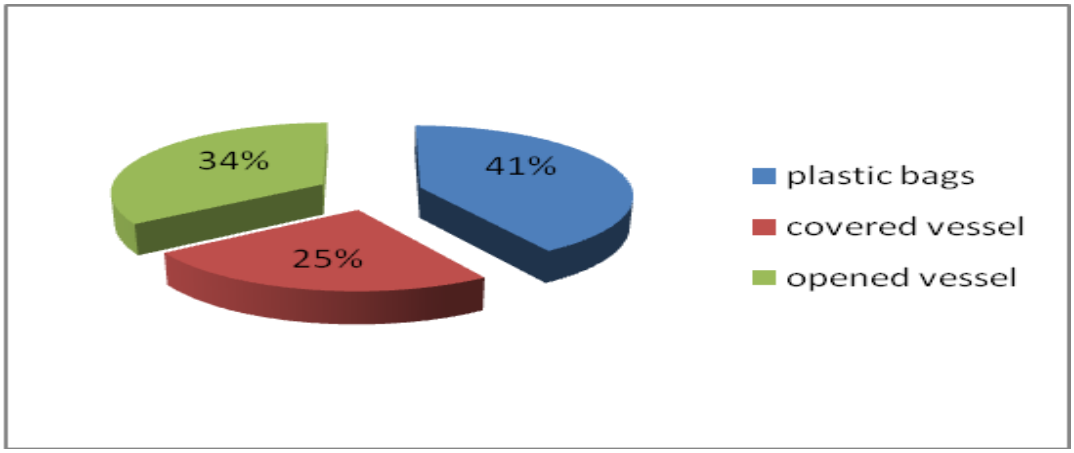


Figure 2: Means of keeping domestic solid waste
Source: Field study 2004

In relation with this, we also noted that there is a discrepancy between the populations of the city's localities in how to save garbage at home. In the locality of Abu Mansur, we found that 28% of the population keeps it in covered containers, and 39% of them keep them in plastic bags, and 33% use open containers. While in the locality of Al- Maghar 15.3% of the population using covered containers, and 33.7% use plastic bags, and 51% of them use open containers, (Table 1), so there is a difference in the level of environmental awareness among the population of the localities within the city in how to deal with garbage before removing it from the house.

Table 1: the variation in the use of keeping waste means

Keeping	Plastic bags		Covered vessel		Opened vessel		Total	
Districts	repetition	proportion	repetition	proportion	repetition	proportion	repetition	proportion
Abu Mansour	64	%39.0	46	%28	54	%33.0	164	%44.3
Albilad	09	%69.2	03	%23.1	01	%07.7	013	%03.5
AlJubaila	44	%49.4	26	%29.2	19	%21.3	089	%24.1
Almaghar	35	%33.7	16	%15.3	53	%51.0	104	%28.1
Total	152	%41.1	91	%24.6	127	%34.3	370	%100

Source: Field study 2004

ii. The commitment of the people in removing the waste out of houses on specific dates

This means the to which extend the citizens are aware of the importance of hygiene and the importance of assisting of those who are responsible for garbage collection and transfer, through the commitment of these people to remove garbage from their homes and put them in reach for the cleaning authority in a scheduled and fixed time, according to this the responsibility of the cleaning authority should fix a collecting dates and times and should inform the residents of the localities.. In this regard, the study indicated that 61% of the families are committed to the specific dates of removing the garbage from their houses, and 39% of them do not conform to the schedule (Figure 3).

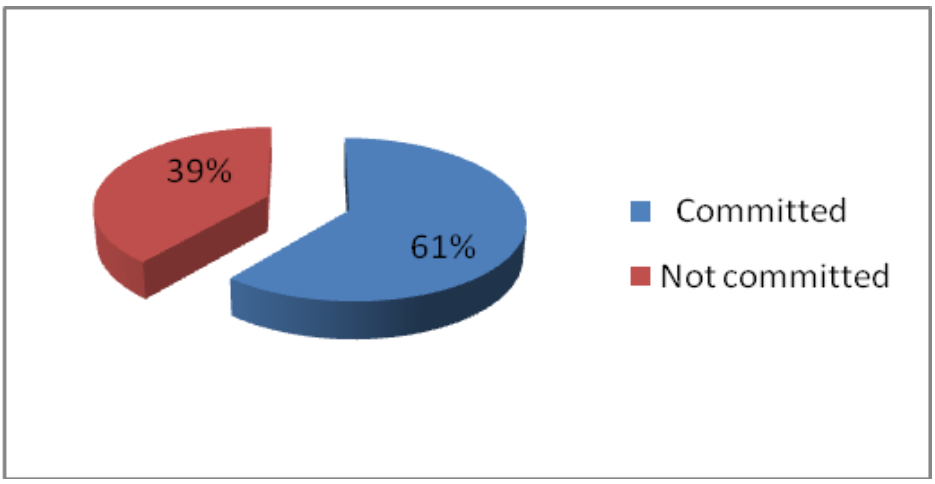


Figure 3: The commitment of families in remove waste on specific time
Source: Field study 2004.

The non-existence of cleaning campaigns in the city to help the cleaning authorities, has a big role in increasing the amount of garbage, and worsen the problem, this shows the extent of environmental awareness among citizens, and the lack of attention to cleanliness of the environment in which they live, it indicates that what concerns the resident is just to clean his house.

b. Underperformance of the responsible authorities and the variability of services between the city's localities

The Environmental Protection Agency (EPA) is responsible of all the cleaning process in the city collect, transport and the disposal of the garbage. And also to provide all cleaning equipments and machinery, but there are some shortcomings in the Agency and its services, they are as follows:

i. Lack of specialized employees in cleaning tasks

The (EPA) in the city of Derna includes about 233 employees in charge and responsible for the collection, transfer and the disposal of the garbage, either directly or indirectly, each of them has a specific task; these people can be divided into five categories as follows:

Regular labor: This includes persons who are directly involved in the process of collecting garbage, both in front of houses or from the container in the streets and public squares, they also clean up and sweep the streets from the accumulated garbage and load it into trucks.

Drivers: They drive all kinds of cars and the cleaning relevant mechanisms including light and heavy cars for demolition, landscaping mechanism and sweeping the streets.

Technicians: This category is specialized in all maintenance and repair of all equipment and machinery in the agency.

Field Supervisor: This category is responsible for monitoring and follow-up the previous categories works in the specified time and locations, and to ensure that all workers do the work assigned to them fully.

Administrators: As for this category, they are not directly related to the implementation of the work of city cleaning, but they are responsible for the work and other services concerning the management of the agency and the staffs like to prepare, pay the salaries, planning the leaves, and providing facilities. In addition to that they also provide equipment and machinery needed for hygiene (Lama 1998).

Based on this categorization an statistics have been made on these groups and their sufficiency, it is clear that the Agency comprises of about 233 Employees, 2 managers and 12 Field Supervisors, both categories are enough number to carry out their work fully. There are also about169 Labors, 35 drivers, and 15 technicians (Table 2). Based on the opinion of one of the officials in the (EPA), these last three groups numbers is insufficient to perform the work easily and fully. Due to the heavy amount of solid garbage that comes out of the city every day which doesn't go well with the numbers of these workers and, consequently, this shortage will increase the accumulation of solid garbage for long periods without collection.

Table 2: The Employees of (EPA)

Employment categories	The number	Rate	Adequacy
Regular laborers	169	73%	not enough
Drivers	35	15%	not enough
Technicians	15	06%	enough
Field Supervisors	12	05%	enough
Administrators	2	01%	enough
Total	233	100%	#

Source: Field study 2004.

ii. Equipment and machinery of cleaning

This Includes trucks to transport garbage and other equipments to sweep the streets, destruction and landscaping in addition to garbage collection containers. Table 3 shows that the (EPA) in Darna city have 12 private trucks to the transfer of solid garbage, including 3 large size pressuring trucks capable of transporting garbage automatically from the containers in the streets, and 4 small size pressuring trucks capable of transporting garbage automatically from the containers as well, and 5 trucks of opened standard size used to transfer garbage from the front of the houses immediately and are also used to transport solid garbage and other garbage like demolition, construction remnants and street sweepings, as well as 2 numbers of the demolition and landscaping bulldozers. The number of trucks and machinery is not sufficient to cover all the work of the city's daily cleaning, as for street sweepings trucks, they are not available at all, the ordinary labors sweep the streets manually. With regards to the garbage collection containers they are (350) containers randomly distributed in some streets of the city, but also the number is not enough to collect all garbage that come out every day from homes, shops, and other places, 38.9% of Domestics asserted that non-availability of containers near their homes, with more than 61.1% of them said that there are no responsible authorities for these containers. Only 25.7% of these available containers are enclosed or covered so that they reserve the garbage inside to

prevent the scatter and the spread of aromas, and the other 74.3% of the available containers are open, leading to the scatter the contents by some animals such as cats and especially when it filled (Table 4).

Table 3: Equipment and machinery of cleaning

The type	The number	Adequacy
Large trucks	03	not enough
Small trucks	09	not enough
Street sweepings trucks	00	not enough
Demolished bulldozers	02	not enough
Containers	350	not enough

Source: Field study 2004.

Table 4: The availability and type of containers near homes

	The availability of container			The type of container		
	available	not available	total	covered	opened	total
Repetition	144	226	370	37	107	144
Proportion	39%	61%	100%	25.7%	74.3%	100%

Source: Field study 2004.

The containers play a key role in the process of garbage collection, the method of collecting the garbage from it depends upon the type of material they are made of , their size and design in terms of their dynamic and static stage, where appropriate large containers in size with trucks equipped with cranes unloading machine, but in terms of capacity, there a strong relationship between population density and capacity of containers that should be provided to accommodate the garbage, and they must be placed at a suitable distances for the population (Abdalsama 1992).

iii. **Methods used in the waste collection in the city**

There are many methods through which solid garbage are collected within the localities of the city, one of these methods is to collect in containers or upload the garbage directly to the transport trucks and transfer it directly to the final disposal sites. Due to the clear lack of containers, we found that 17.6% of the residents of the city dispose their garbage in containers designed for that, and that 40.8% of them dispose their garbage by direct uploading to the transport mechanisms, while 41.6% of those residents do not find the appropriate way for the garbage collection and disposal, so they throw them in open places, the streets and public squares as a result of that the garbage is accumulated in the streets and public squares in the city (Figure 5).

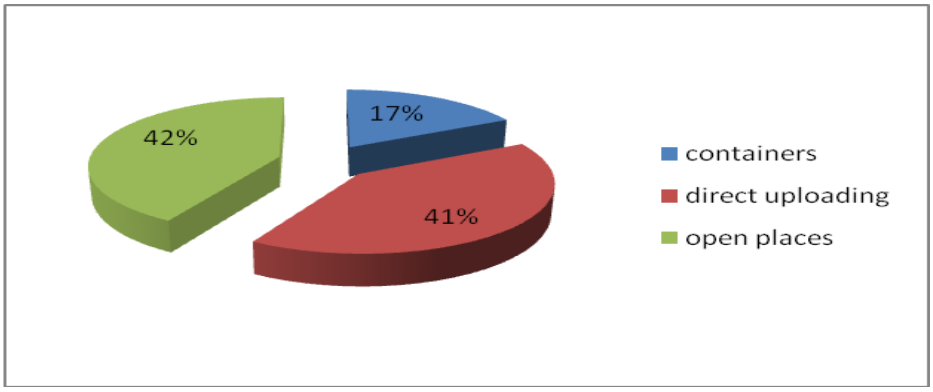


Figure 5: Method of waste collection in the city
Source: Field study 2004

The study indicated that 40.8% of the residents of the city said that there is no garbage accumulated and stacked in the streets and fields because of the continuing work of cleaning, while 59.2% said that the accumulated and stacked garbage may remain for a period exceeding 5 days before being collected and transported by the (EPA), this happens because of the underperformance of the cleaning responsible authorities of the city and the insufficient number of provided equipments and machinery, appropriate with the population density and lack of follow-up to the daily work of cleaning in the city (Table 5).

Table 5: The extent and period of waste accumulation

	The extent of waste accumulation			Period of waste stack			
	stack	do not stack	total	2-3 days	4-5 days	More	total
Repetition	219	151	370	59	33	127	219
Proportion	59.2%	40.8%	100%	26.9%	15.1%	58%	100

Source: Field study 2004.

As shown in Table 6, there is a variation in services done by the (EPA), related to the differences in how garbage are collected between the localities of the city, we find, for example in the locality of Abu Mansur that 20.1% of residents dispose their collected garbage in containers, and 32.9% dispose their garbage by direct upload to the garbage transfer trucks directly in front of their houses, while 47% of the pool dispose garbage by throwing it in open spaces due to the lack of containers nearby or due to non-passage of trucks regularly. In the locality of Almaghar, we find that 6.7% of residents use containers for the disposal, and 68.3% of them dispose their garbage directly by uploading to the trucks, while 25% of them throw it in the open spaces for the same reason mentioned above. There is also a further evidence for the lack of services by the Environmental Protection Agency and the varying services between the localities of the city, which is how long the garbage remains stacked in the streets and fields of some localities. It is shown in the Table 7 which shows that there is a variation in the duration of the remain and accumulation of solid garbage among the localities of the city, for example, in the locality of Albilad approximately 76.9% of residents confirmed the remain of the accumulated solid garbage without collection for a long time, while 23.1% of them do not confirm the remain of this accumulated garbage, while in the locality of Maghar it indicates that 37.5% of residents confirmed the remains of the accumulated garbage, while 62.5% of them referred to non

existence of the accumulation of garbage because they are being moved quickly from their generated places.

The reasons for this discrepancy might be due to the poor urban planning and narrow streets in the locality of Albilad, as it is considered the oldest locality in the city and therefore difficult to access mechanisms for cleaning them. The large number of markets and shops in this region increases the accumulation and spread of garbage.

Table 6: The variation in the (EPA) services between the city's neighborhoods

Agency's services	Container		Direct uploading		Open places		Total	
Districts	repetition	proportion	repetition	proportion	repetition	proportion	repetition	proportion
Abu Mansour	33	%20.1	54	%32.9	77	%47.0	164	%44.3
Albilad	02	%15.4	03	%23.1	08	%61.5	013	%03.5
AlJubaila	23	%25.8	23	%25.8	43	%48.4	089	%24.1
Almaghar	07	%6.7	71	%68.3	26	%25.0	104	%28.1
Total	65	%17.6	151	%40.8	154	%41.6	370	%100

Source: Field study 2004

Table 7: The relationship between city districts and extent of waste accumulation

Extent of waste accumulation	Remain		Not remain		Total	
Districts	repetition	proportion	repetition	proportion	repetition	proportion
Abu Mansour	111	67.7%	53	%32.5	164	44.3%
Albilad	010	76.9 %	03	%23.1	013	03.5%
AlJubaila	059	66.3 %	30	%33.7	089	24.1%
Almaghar	039	37.5%	65	%62.5	104	28.1%
Total	219	59.2	151	40.8	370	100%

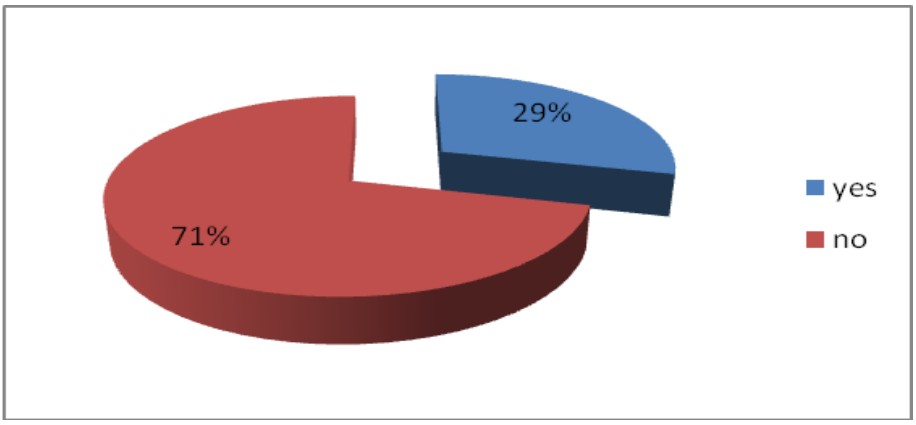
Source: Field study 2004

c. Role of the responsible authorities in the dissemination of environmental awareness

Media is the most important means by which to promote environmental awareness among citizens and inform them of what is happening in their environment. Even though that the Third World owns many scientific institutes and government agencies with environmental responsibilities, their roles are still weak in highlighting the environmental problems facing the communities. The process of environmental awareness among citizens and urging them to cooperate to create a cleaning campaigns in the city in order to maintain general cleanliness of their environment and disposal of solid garbage. It is not an easy process, it needs experience depends on good utilization of media to address the problem of accumulation of solid garbage and how to get rid of them. And here comes the role of official bodies in the dissemination of environmental awareness among citizens through orientation about the importance of cleaning ,health procedures and proper disposal of solid garbage to reduce its impact on the environment,

in addition to that campaigns of cleaning should be started, and to consider the cleaning as a society issue of belongs to all its members and its organs, and this is only possible through the cooperation of the citizen with a cleaning and environmental protection agency to alleviate the aggravation of the problem (Al-Arfi and Al-Siddeeq 2002).

Accordingly, the study indicated a weaker contribution of the responsible authorities in the field of environmental awareness of the citizen, and according to an opinion poll of citizens in this regard (71.1%) have confirmed the failure of the responsible authorities in their contribution to the awareness of the citizen and to inform them about the importance of cleaning, when (28.9) % of them indicated that there is some means of awareness done by the responsible authorities through various media, most notably radio, television, newspapers and magazines (Figure 7). With regard to the city of Derna the Environmental Protection Agency confirmed that they did not commence any conferences and seminars to educate citizens in order to preserve the environment and pay attention to the cleaning importance.



Source: Field study 2004

Figure 7: The extent of responsible authority's contribution in deployment of environmental awareness based on a poll of citizens

The reasons of the disability Environmental Protection Agency of the city include:

a. Low salaries of the employees in the agency and the unwillingness of many citizens to work in this job and the lack of financial incentives to workers.
b. Lack of funds to the Environmental Protection Agency.
c. Non-arrival of waste transport trucks to some areas of the city because of the narrow streets and lack of paving.
d. The lack of sites dedicated to throw garbage, away from residential areas

d. The amount of solid garbage and its components in the city

The transfer of domestic garbage and disposal of it through a group of trucks of different sizes in 2 to 3 trips per day, it transfers what from the city (garbage produced by the city) about 70 tons. (Environmental Protection Agency 2004) per day, or about 25 550 tons per year. Accordingly, it has been estimated that an individual produces about 714 gm per day. Table 8 shows that domestic solid garbage in the city of Derna contains 70% organic materials, 11% paper, 7% plastic, minerals 5%, various other materials 5% and glass are 2%.

Table 8: components of domestic solid waste in the study area

Content of waste	Organic materials	Paper	Plastic	Metal materials	Glass	Other materials	Total
Proportion	70%	11%	7%	5%	2%	5%	100%

Source: Environmental Protection Agency 1999

e. Methods of getting rid of the domestic solid waste which is followed in the city

Darna city depend in the disposal of their domestic solid waste on one of the oldest ways that is throwing down in the open containers and then burnt without any processing, and what makes matter worse is, these containers is not far from the residential area an adequate distance, but they are on the border of the cities scheme, and the existence of such a container in the Alhaseen valley east of the city lead to leakage of pollutants with rainwater to groundwater or drawn to the sea. The city has tried to rely on one of the modern methods of garbage treatment, where an organic fertilizer factory was established in order to convert organic garbage to fertilizers, but this factory worked only for a very short period and remained closed.

CONCLUSION

This study attempted to reveal the key factors that led to domestic solid waste pollution in the city of Derna, Libya. The study found that there were several combined reasons have led to this serious environmental problem included the negative behavior of citizens, and the lack of interested to clean their environmental. Where some of the residents do not put the garbage in the place reserved for it. Underperformance of the Environmental Protection Agency and the variation of services between the city's localities, and the lack of financial capacity have increased this problem. And thus, the waste became accumulated in the streets and open places.

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