CHARACTERISTICS AND COMPOSITIONS OF SOLID WASTE IN NASSIRIYA CITY

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Abstract:

The improving of living condition and increasing of population density growth assist in increase the quantity and quality of domestic solid waste in households in Nassiriya city.

A samples of solid waste have been collected from households in Nassiriya city to know the quantity of solid waste generated. Households classified into three zones according to economic status (high, middle and low income levels). Samples collected for seven months, from January to July 2008.

This paper explains that the generation rate of solid waste for person or capita changes from each income level to another and from month to other and we can represent 0.68 kg/cap./day as average of domestic solid waste generated in present time in city, the quantity of solid waste generated in Nassiriya city is equal to 22.15 ton/day this only for domestic waste (solid waste from commercial, industrial and medical waste not reported in this paper).

Value of density was calculated is equal to 275.33 kg/m^3, the percent of each individual component for solid waste components also calculated and for seven months for each income level. These percent shows that the most common components is organic (food) waste which is participle and its percent in range of (61.88 % to 69.95 %) and these value is similar with other results in other cities of Iraq.

The compressive of results of this paper with other results shows its similar to Iraqi cities and differs to Europe united cities.

Keyword: Solid Waste management, Waste composition and characteristics, Nassiriya city

خواص ومركبات النفايات الصلبة في مدينة الناصرية

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المستخلص

إن تطور الظروف المعيشية وزيادة الكثافة السكانية ساعد في زيادة نوعية وكمية النفايات الصلبة المنزلية المتولدة في مدينة الناصرية. تم جمع عينات لمعرفة كمية النفايات الصلبة المتولدة من المنازل في مدينة الناصرية. قسمت المدينة الى ثلاث مناطق بالاعتماد على الحالة الاقتصادية (المستوى المعاشي للمنطقة) الى مناطق مرتفعة، مناطقة متوسطة ومناطق ضعيفة الدخل. واستمرت الدراسة لمدة سبعة اشهر من شهر كانون الثاني الى شهر تموز

٢٠٠٨. أوضحت الدراسة إن معدل النفايات التي يولدها الشخص الواحد تتغير من فئة إلى أخرى ومن شهر إلى أخر ويمكن اعتماد رقم ٠.٦٨ كغم /الشخص/اليوم كمعدل للنفايات المتولدة في الوقت الحاضر وبذلك تبلغ كمية النفايات الكلية المتولدة من المنازل فقط حوالي ٢٢.١٥ طن / اليوم في مدينة الناصرية عدا النفايات التجارية والصناعية والنفايات الطبية المتولدة من المستشفيات والأنشطة الصحية.

أما قيمة كثافة النفايات الصلبة فقد تم إيجادها ووجدت إنها تساوي ٢٧٥.٣٣ كغم /م٣ كما تم حساب النسبة المئوية لكل مكون من مكونات النفايات الصلبة وللأشهر السبعة كما تم حساب الانحراف المعياري ومعدل نسبة كل مكون لكل فئة من فئات الدخل. وقد بينت النسب المئوية إن النسبة السائدة للنفايات هي النفايات العضوية القابلة للتعفن والتي تراوحت بين (61.88% إلى % 69.95) وهذه النسبة تتشابه مع النسب الأخرى التي تم إيجادها في باقي المدن العراقية.

كما تم مقارنة النتائج التي تم الحصول عليها في هذا البحث مع ما متوفر من نتائج وأرقام عن الدراسات السابقة التي أجريت على مدن أخرى من العراق وقد أظهرت تشابهها مع هذه القيم واختلافها عن مثيلاتها في مدن الاتحاد الأوربي.

Introduction:

Solid waste is any solid material that is disposed of because it has no further use to society in its present form. In more specific terms, the U.S. EPA has defined a solid waste as "any discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, agricultural operations and from community activities" (Bishop, 2000).

Solids wastes are produced wherever man is found farms, mines, stores, offices factories, homes, hospitals, streets, and even the primitive encampments of traditional nomads(Rao, 1994).

Data on the amount, sources and characteristics of refuse in a city should be the basis to the planning, designing and satisfactory operation of solid waste management (storage, collection, transport, and disposal) systems and the application of disposal methods. Essential data can be gathered through physical survey. The quantity and quality of solid waste generated may be affected seriously by local conditions (climate, seasons, socioeconomic conditions, income levels, etc.) and the type and activity of the source (Kirov, 1975). Domestic or households Solid waste is managed by the Ministry of Municipalities and Public Works .

It is necessary to have a detailed study about area land use in any city in order to know the size and quantity of solid waste generated and to determine the way of collecting and treatment it. **Figure (1)** shows the current and suggested use of land in all sectors of the city according to the master plan.

It is noticed that the area of land used for residential is about 15.82 km^2 and it represents about 28% from the total area, while the area used for the commercial activities is about 5.٦٥ km^2 and it represents to 10% and it is focused in the old part of the city (old city square).

The area of land used for industrial purpose is about (2.61 km^2) and represents 4% of the total area of the city, the major industrial activities are: Ur State Establishment for Mechanical Industries contains three large industrial (Aluminum Processing Plant. Cable Plant, Wood Role Plant), Nassiriyah Textile factory, Thi Qar Oil Refinery, Thermo Power Station and The Asphalt Plant.

There is also about 2.6 km^2 and represents 4% from the total area is dedicated for industrial storage, moreover there is an industrial site about 1.3 km^2 and represents 1% form

the total area and the most workshops of car maintenance and repairing are concentrated in this area, the majority of waste generated in this area are un useful part of cars and scrap.

The public services cover about 9.2 km^2 and represents 15% from the total area and there is area concerned with the service sector covers 3.1 km^2 which equal to 7 % of total area. The green areas cover about 6.05 km^2 and this represents 11% form the total area, where the water surface (Euphrates River and main out fall drain) covers area of 3.07 km^2 which equal to 5% of total area. The future expanding will be about 7.6 km and that will represent 14% from the total area.

Scope Of Work:

Nassiriyah City the centre of Thi Qar Governorate and it lays on south of Iraq at about 360 km south east to Baghdad, between 30° 56′ to 30° 59′ in north and on 46° 15′ in east .

According to the Central Census Organization (2008), the total population of Nassiriyah city is about 472000 person, distributed as (423500 are in urban areas, while 48500 are in the rural areas. The total area of An Nassiriyah, according the to master plan, is about 57 km^2 and the total number of houses 48500 house (Nassiriyah municipality office).

Waste Collecting Processing In Nassiriyah City:

An Nassiryiyah Municipality office is responsible for solid waste management (collecting, transportation and disposal) the municipality divided city to seven sector in order to facilitate solid waste management, theses sectors are:

1. **The Old City Square Sector**: it includes the quarters of Tammoz, Al Sherqiya, Al Majed, Nissan, Aledarah el mahaliya and Al Bashaer. These quarters are among the high income and it includes the commercial center of the city and other governmental offices.
2. **Al Salihiya Sector**: it includes the quarters of Al Salihiya, Al Shuhada and Al Hussien.
3. **Al Sader Sector**: it includes the quarters of Al Sader, Al Rafidain and Ur, this sector covers also the main terminal and many governmental offices.
4. **Sumer Sector** : includes the quarters of Sumer, Al Muaalmeen and Arido.
5. **Khalf El Sareea Sector**: It includes the quarters of Al Zahraa, Al Tadhiya, Al Buqaa and Al Fida'a.
6. **Al Thawra Sector**: it includes the quarters of Al Thawra, Al Mansoriya, Baghdad Street. Al Mutanazah, Al Taqa and Al Eqtisadiyeen.
7. **Al Shimookh Sector**: it includes the quarters of Shimookh, Shuala, Iskan Qadeem, Isakn Sinaee and Imarat el Sakaniya. The Headquarter of Thi Qar University with some colleges and most large industrial plants in addition to the main stadium located in this sector .

The main equipments used in solid waste collection are:

- tractor 4 ton capacity.
- Ordinary truck 2 ton capacity.
- waste collection Truck (4 and 8 ton capacity).
- trolley.
- Waste truck (for bulk transportation).

Methodology:

Information about the population, were collected and classified into three groups of income: high, middle and low.

Three regions were selected to conduct the study on. Samples were taken randomly but according to the different socio levels, **Figure (2)** shows the master plan (essential design) for

Nassiriya city including location of sampled areas for low-income, middle-income and high-income level, major dumping / landfill areas and industrial site.

Random samples were gathered from each region and from the three different income levels (see **Table (1)**) provided samples plastic bags were distributed to the selected households to collect its waste in and number of occupants was recorded. Bags are to be collected each the other day and replaced by another; and so on for seven months in each of income level. Collection crews transferred the plastic bags of wastes from nominated houses, weighed individually and labeled according to its socio-economic classification.

The monthly samples collected from the nominated houses were weighed and randomly mixed, the basic weight was hand sorted into nine individual components making up the two broad categories of combustible and non –combustible as follows:

(a) Combustibles

(i) Organic (putrescible): including all wastes from selling, preparation, cooking, and serving food.
(ii) Paper: all kind of waste paper, newspapers, and cardboard.
(iii) Plastics: all varieties
(iv) Textiles and Rugs: all textiles, synthetics, wood, leather
(v) Misc. combustibles

(b) Non-combustibles

(i) Tins, cans and metal: ferrous and non-ferrous
(ii) Glass: non-returnable bottles, soft drink bottles, broken glass, ceramics, ..etc.
(iii) Cleaning waste : garden waste, dust ,etc.

The refuse density was calculated by dividing the total refuse weight by the bulk volume of the refuse.

Results:

1 Waste Generation Rate:

Generation rate is represent quantity of wastes as a function of volume or weight. Most studies used weight as a function of generation rate because it was not effected by compaction in transfer process.

Generation rate is very important to design a system of solid waste management and is effected by many local factors, including time of year, habits, education, economic status of the people, and location. **Figures (3, 4)** show solid waste generation rates and density in Nassiriya city obtained in this paper for seven months.

From **Figures (5, 6)** average solid waste generation rates and density were calculate as (0.70 kg/capita/day, 293 kg/m^3), (0.72 kg/capita/day, 249 kg/m^3), and (0.63 kg/capita/day, 284 kg/m^3) for high, middle, and low income levels respectively. Average solid waste generation rate and density for all city were (0.68 kg/capita/day, 275.33 kg/m^3), total solid waste generation for Nassiriya city was (221467.7 kg/day).

Quantities of solid wastes vary considerably in composition and quantity depending on the economic status and ethnic composition. Quantities also vary with seasons, horticultural choices, and geographical characteristics of land, rainfall, climate, and habits of people: what they eat, drink and the packaged materials they buy. Variations also depend on the availability of fresh fruits and vegetables. Residents of large cities and towns tend to throw away more than residents of small towns and villages do (CEHA, 1995).

There is considerable confusion on generation rates of solid waste. This is because of the different methods of measurement and different waste classification adopted for reporting data. The reason for measuring generation rates is to obtain data that can be used to determine

the total amount of wastes to be measured. Therefore, in any solid waste management study, extreme care must be exercised in allocating funds and deciding what actually needs to be known.

The value of generation rate in summer season higher than it in winter season, the reason for this summer in Iraq increasing in production food spatially Vegetables and fruits .

Different generation rates were obtained through studies carried out in some Iraqi governorates at different time of the year. Generation rates varied from 0.35 kg/capita/day for Faluja city (Al-Jumaily, 1998) to 0.420 kg/capita/d. for Najaf (Hamoud, 2005) to 0.7 kg/c/day for Baghdad (Qasir, 1978). **Table (2)** shows a clear comparison in solid waste generation rates throughout the Iraqi governorates.

2 Density:

Knowledge of this property of waste is needed for any transportation or dumping operation. Also of importance is the trend for the bulk density to decrease with the growing proportion of paper and plastics in refuse. The relationship between bulk density and applied load is of special interest to municipal authorities due to the increasing use of compaction vehicles to collect domestic waste (Kirov, 1975).

Density (D) was measured by using a cylindrical container of 0.0185 m^3 volume (V). The container was filled by the shovel; with out compressing it, the container was rocked back and forth for several times during filling then weighed of it (W) to find the density of the wastes using the equation (1):

$$D = W / V \quad (1)$$

Data of density were drawn in the **Figures (4, 6)** for each income level, the average density of the different income levels varied between (232) and (335) kg/m^3 for low-income level, and between (215) and (281) kg/m^3 for Middle-income level, and between (243) and (368) kg/m^3 for high-income level, while the highest average density value that is (368) kg/m^3 for high income level in January month. **Table (3)** show a comparison of the average densities for cities in Iraq with values of density appears in this paper.

3 Waste Composition:

Unfortunately, information regarding the composition of the urban wastes in Iraq is not generally available, as the municipalities do not carry out regular analysis. In fact, wastes are very heterogeneous in composition, and the geographical, temporal, and seasonal variations in its composition make it difficult to define a "typical waste". However, there are some studies carried out in some governorates through out of Iraq at different time of the year. As for example, Al-Najar (Al-Najar, 1998) indicated an organic content of 63%, and a waste density of 469 kg/m^3. Hamoud (Hamoud, 2005) indicated an organic content of 69.03% in Al-Najaf city, while Al-jumaily (Al-Jumaily, 1998) declared that the most common category in the composition of Faluja municipal waste is the food waste (70.6) %.

In this paper from data shown in **Figures (7, 8, 9, 10, 11, and 12)** concluded that the most common category in the composition of municipal waste is the food waste the range of it varies from (61.88%) in high income in dry season to 69.95 % in high income in wet season also we show that the percent of organic waste in the wet season is higher than its percent in dry season because of increasing the value of moisture content in waste in wet season. The range of percentage of plastic waste is varies from 4.36% in low income in wet season to 10.68 % in high income in wet season the reason of this variation in wet season using of juice and drinking which put in the plastic material in additional to the socio and economical condition.

Average value of percent for metal waste appear a few difference from season to season for the three income level (5.3, 4.44 and 4.77) for high, middle and low income level respectively in wet season, while in dry season its percent was (4.96, 4.76 and 4.60) respectively the reason of this all people in different income level using matter covered with a metal cover in both two seasons. Percentage of glass waste is (3.41, 3.81 and 5.21) in wet season where in dry season the values of percentage are (4.93,4.75 and 5.12) for each income level respectively. For paper waste the percent is (5.16, 3.85 and 4.57) in wet season, in dry season (5.22, 5.04 and 4.27) respectively for each income level. The percent of rapper and Combustibles waste is in range of (0.79 to 2.24), the average percent of textile waste is varies from (2.27 %) in high income level to 3.25% in low income level in wet season, in dry season it varies from 2.72 in low income level to 3.98 % in high income level). Incombustible waste contains cleaning waste, garden waste, dust, etc. The percent of these waste is (5.65, 5.01 and 4.54) in wet season, in dry season (6.34, 7.73 and 6.83 %) for each income level, the values of these waste in dry season is more than its values in wet season because increasing the sand storm in summer season in Nassiriya city.

Table (4) gives the composition of wastes in some governorate of Iraq and a comparison is made with the urban solid waste from a typical European cities. As is seen in **Table (4)** average paper contents in Iraq cities is about 3 to 5 percent as compared with about 27 percent for a typical European cities. It has been found that as the personal income rises, kitchen wastes decline but the paper, metals and glass wastes increase; the total weight generated rises but the density of the wastes decline (Rao, 1994).

Conclusions:

1. The average daily waste generated in Nassiriya city was 0.68 Kg/capita, where the average value of density is 275.33 kg/m^3 and it is similar to the other values of densities in other Iraq cities.
2. The total yearly solid waste generated in Nassiriya is approach to 8063 ton/year.
3. The largest component of solid waste generated in Nassiriya household is the food wastes (70.18%), plastic (6.75%), metal (3.55%), glass (3.95%), paper (3.42%), rubber (0.24%), textile (0.89%), miscell. (2.54%), and unmiscell. (garden waste) (3.89%).
4. The solid waste generated in Nassiriya influced with the economic statues. The amount of solid waste generated in high income was (37.57 ton/day), while in the low income was (79.75 ton/day).

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Table (1) Social properties of households of sampling

Income level / Properties	High			Mid			Low		
	Max.	Avg	Min.	Max.	Avg	Min.	Max.	Avg	Min.
Household size, person	14	7	3	16	7	3	11	6	3
Total Number of households of sampling	15			25			25		
Total person in households of sampling	100			182			135		

Table (2) Generation rates in some Iraqi governorates including the recent study results

Gov./City	Mosul (Youseif, 1988)	Baghdad (Dheyaa, 2008)	Kirkuk (Al-Najar, 1998)	Najaf (Hamoud, 2005)	Faluja (Al-Jumaily, 1998)	Nassiriya
Gen. rate kg/capita/d	0.54	1.11	0.44	0.42	0.32	0.68
Year	1988	2002	1998	2004	2005	2008

Table (3) Density value of solid waste in some Iraqi governorates

City/State	Mosul (Youseif, 1988)	Kirkuk (Al-Najar, 1998)	Baghdad (Qasir, 1978)	Najaf (Hamoud, 2005)	Faluja (Al-Jumaily, 1998)	Nassiriya
Density) (kg/m^3	280	469	445	473	462.5	275.3
year	1988	1998	1977	2004	2005	2008

Table (4) Components of municipal solid waste as weight percent in some governorates in Iraq and typical European city

Comp.	Baghdad	Mosul	Kirkuk	Faluja	Najaf	Nassiriya	Typical Europe.
Putrescible (food)	69.6	81.0	67.5	70.6	69.03	70.18	30
Plastic	5.3	3.0	6.33	8.1	5.09	6.75	3
Metal	2.2	5.4	8.40	1.3	7.09	3.55	7
Glass	2.2	1.0	2.50	2.2	2.71	3.95	11
Paper	5.0	5.0	1.50	2.6	3.06	3.42	27
Rubber	-----	------	------	------	------	0.24	
Textile	3.0	1.5	2.50	4.3	3.59	0.89	3
Miscell.	-----	--------	--------	-------	------	2.54	------
Un Miscell. (garden waste)	5.0	2.9	3.0	1	3.06	3.89	3
Inert	7.7	----	4.77	10	4.04	------	16
Leather	----	0.2	2.50	-----	1.50	------	

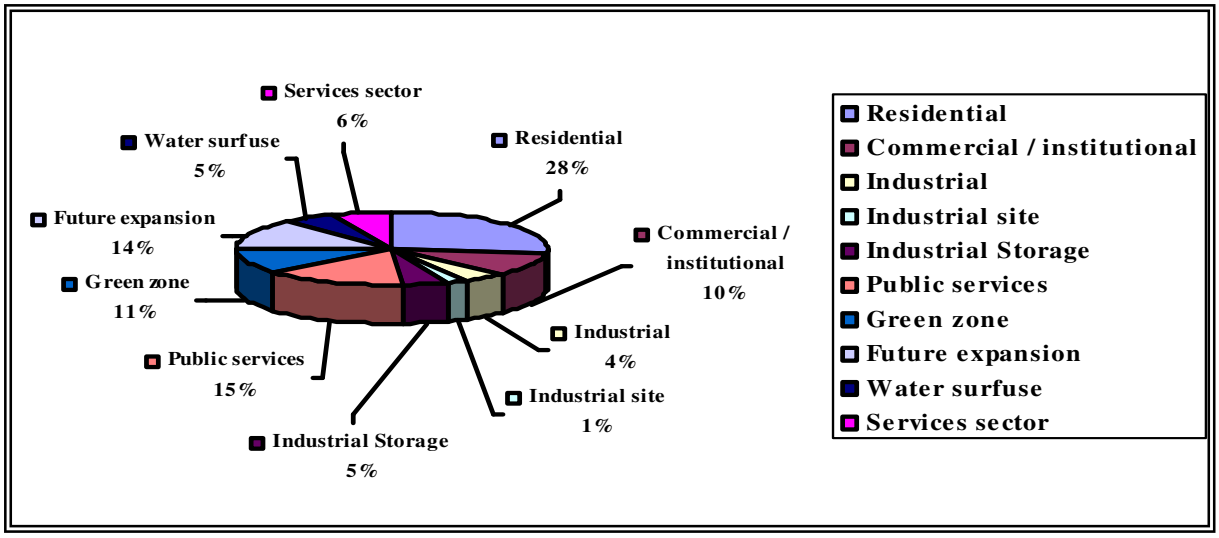

Figure (1): Land use percentage in Nassiriya City

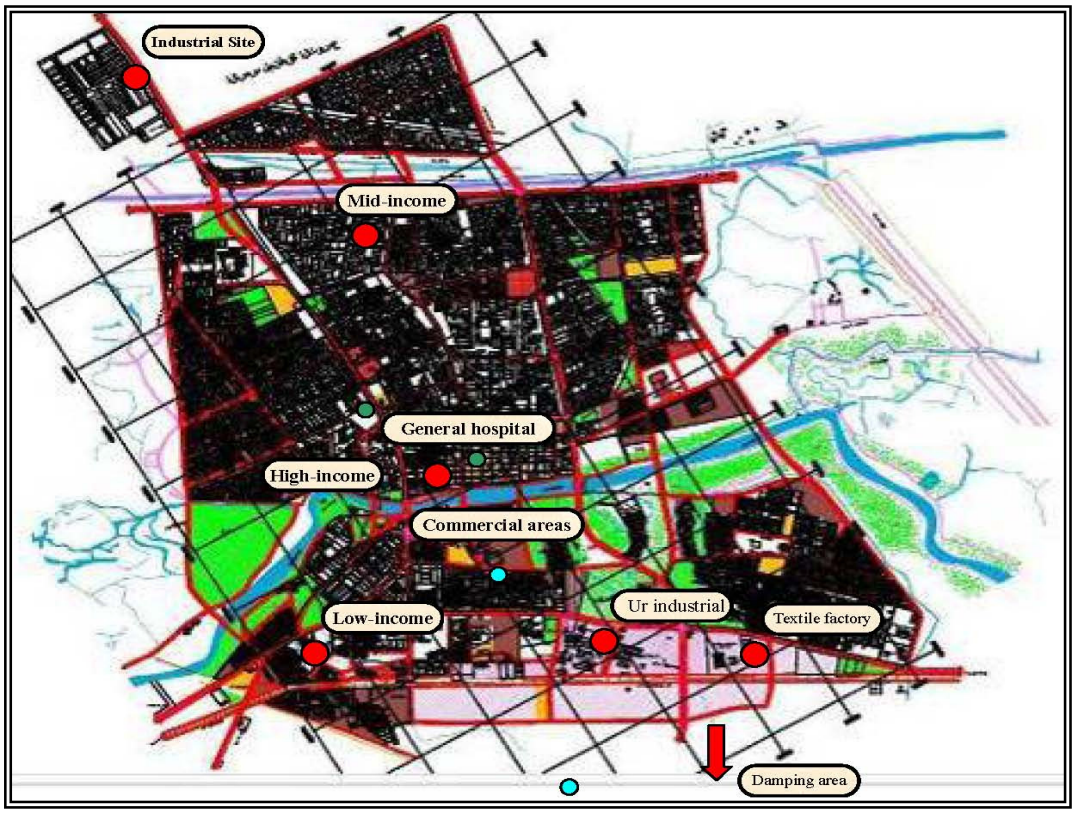

Figure (2): Master plan of Nassiriya City

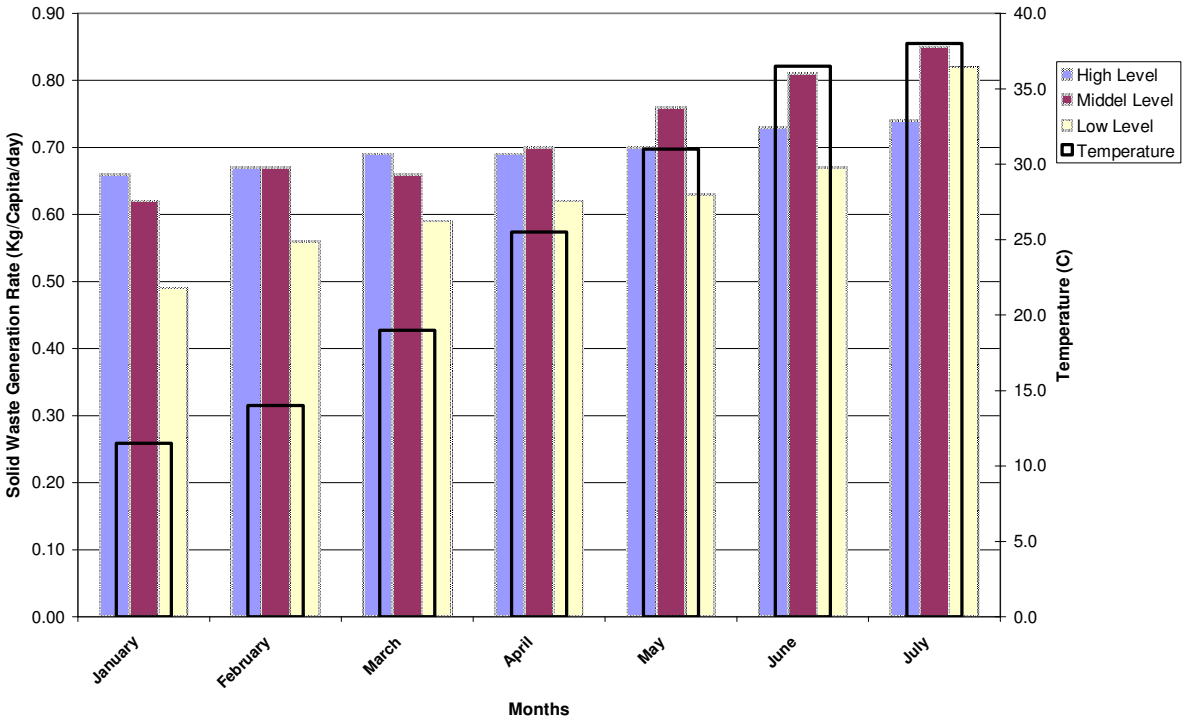

Figure (3): Solid Waste Generation Rate

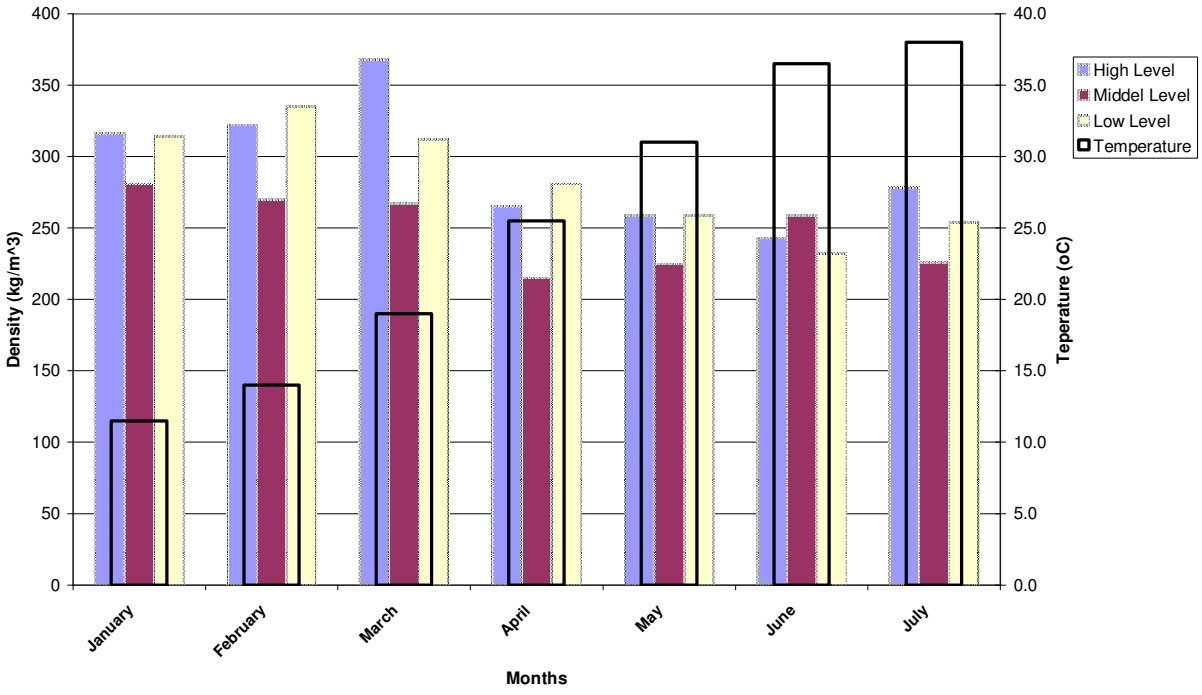

Figure (4): Solid Waste Density

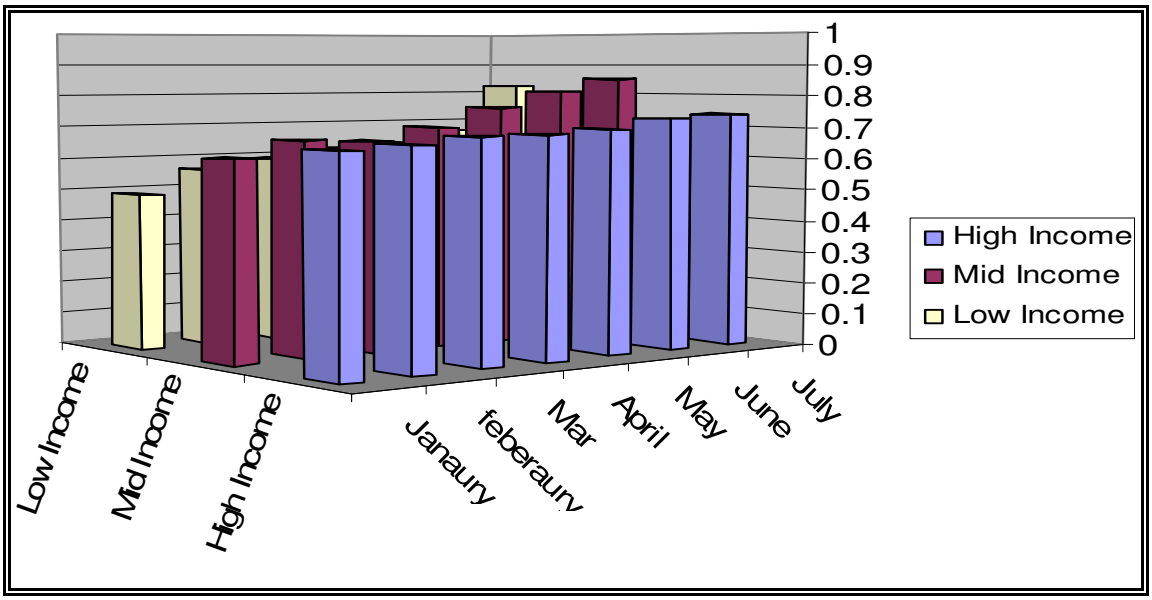

Figure (5): Generation rate for each income level

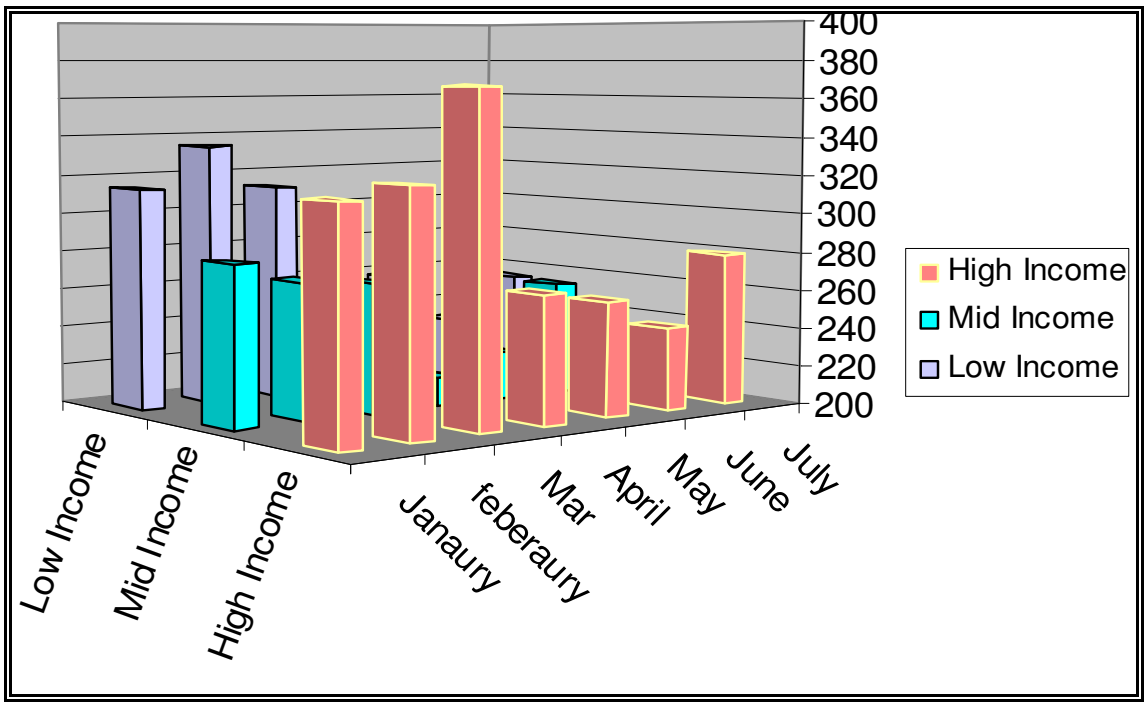

Figure (6): density values for each income level

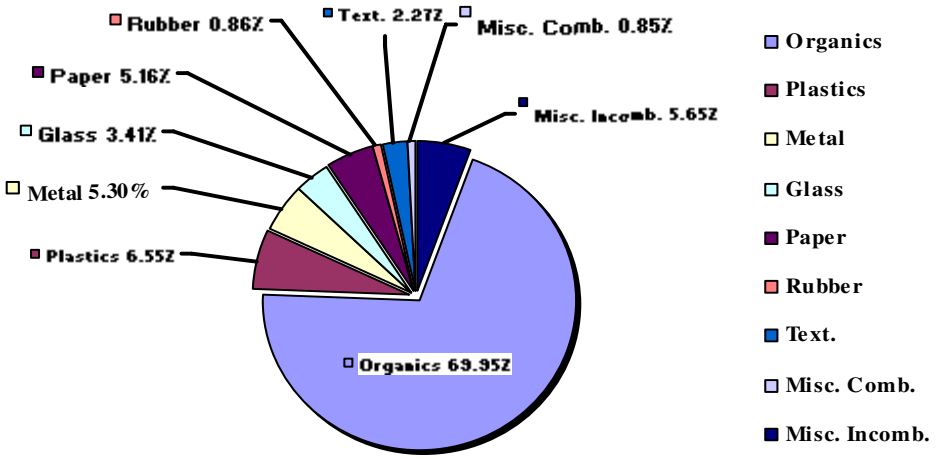

Figure (7): Solid waste component in high income in wet season

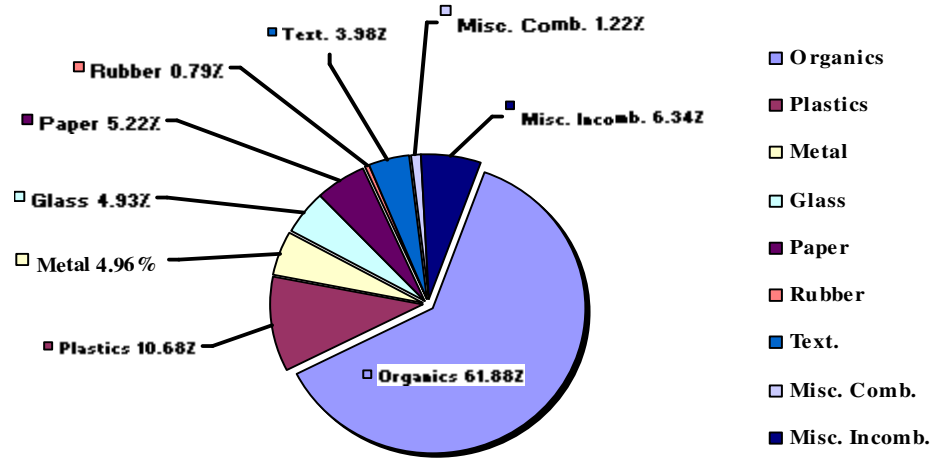

Figure (8): Solid waste component in high income in dry season

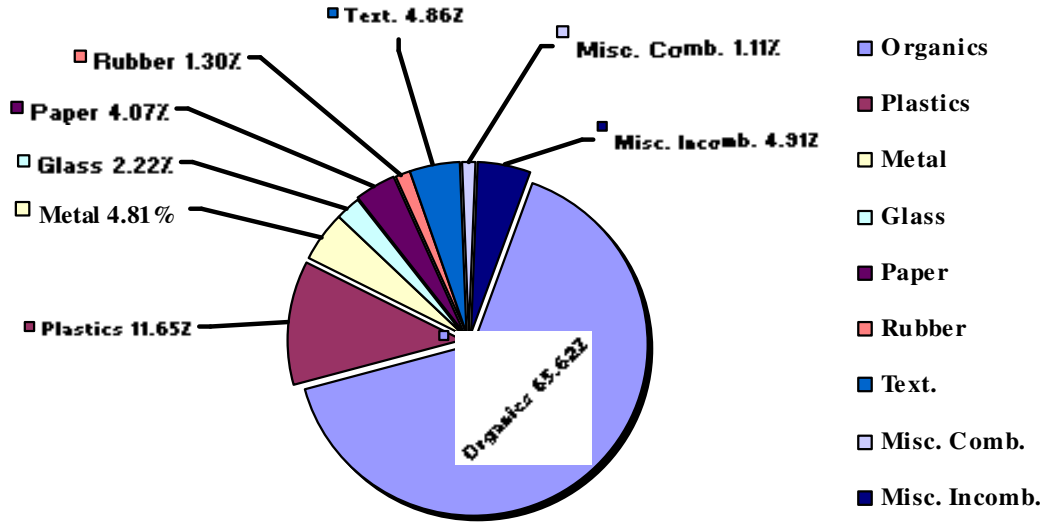

Figure (9): Solid waste component in Mid income in wet season

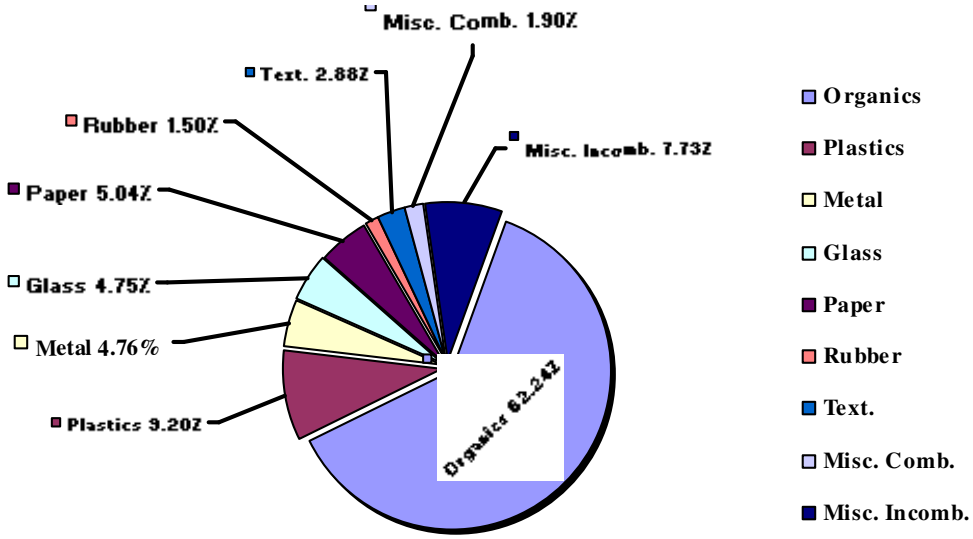

Figure (10): Solid waste component in Mid income in Dry season

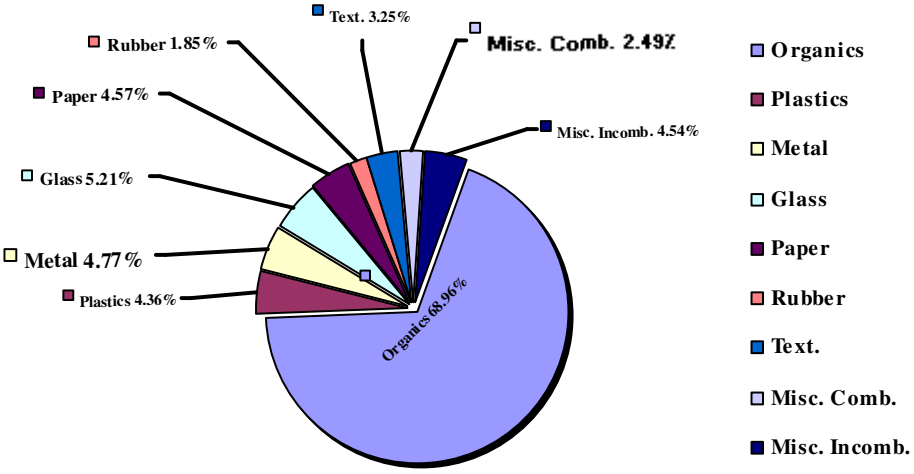

Figure (11): Solid waste component in Low income in Wet season

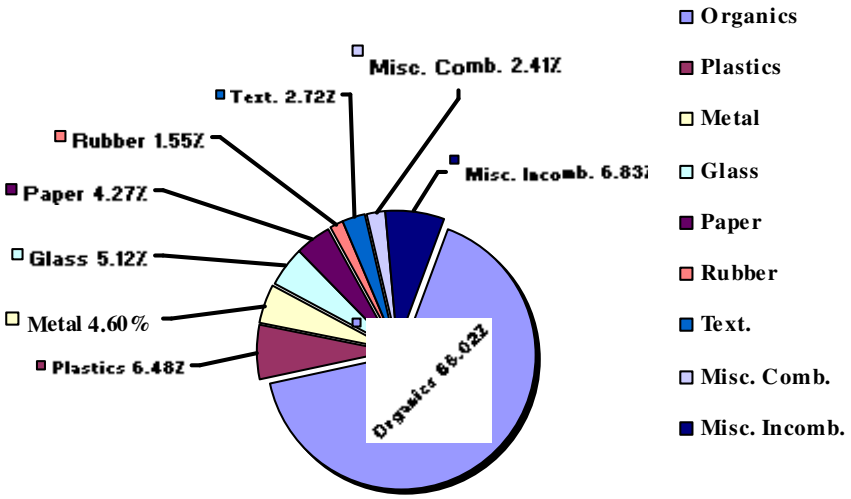

Figure (12): Solid waste component in Low income in Dry season