

Solid waste management and its Environmental impacts on human health in Juba town - South Sudan

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Abstract: Urbanization and population growth are solely responsible for high increasing rate of solid waste in the urban areas and its proper management is a major problem of Municipal Corporation. Juba accordingly was the focus of intensive research. Interviews and observations were used to provide the necessary information. In this study, the sources and components of solid waste were identified, the quantity of solid waste disposed, methods of solid waste disposal and management evaluated, common diseases and disease vectors were assessed and the roles of public health department to solid waste management and workers general health condition were highlighted. Results showed that solid wastes in Juba area were complex in composition and quantity. Shortages of funds, inadequate number of workers, lack of transport and facilities contributed to the mismanagement of solid wastes. Diseases resulting from poor environmental sanitation constitute the bulk of the health problems in the study area. Communicable diseases were highly prevalent. Accordingly, problem of solid waste generation in Juba will continue to magnify and urban environment will uncontrollably deteriorate unless proper management is taken and the public cooperate with public health department in environmental sanitation.

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1. Introduction

1.1 General overview of solid waste management

Management of solid waste all over the world is one of the first important priorities to the protection of community health as well as the environment. Solid waste comprises all the waste arising from human and animal activities that are normally solid and are discarded as useless or unwanted disposal (Tchobanoglous, et al. 1993). Wastes can be generated by natural phenomena such as wind, erosion, precipitation, volcanic eruptions, flooding of river banks, atmospheric fallouts, among others and by human activities including domestic; commercial, industrial and agricultural practices (ACS, 1969, Eipper, 1970 and Moncrief, 1970). Among the factors contributing to wastes generation in Juba are: rapid population growth and high concentration of the population in urban areas, industrial development, changes in eating habits, and the widespread use of disposable containers and packages resulting in huge amounts of waste. The magnitude of wastes generated from human activities alone may exceed 18,000 tons

per year for a developing area (Habbit, 1989 and Onibokun, 1989). 1967).

In South Sudan today and Juba in particular, urban centers are experiencing an increased rate of environmental deterioration with refuse dumped along drainage channels and commercial centers.

In South Sudan and Juba in particular, two main systems employed in collection of solid waste are: the system of house-to house collection and the primary collection system where people bring their refuse to a communal waste containers (communal ground-dumps) placed at a specific place in an area where municipal trucks come to collect it.

Therefore, the major objective of this work was to investigate the management of solid waste in Juba town and highlight the health problems posed by high waste generation. Whereas the specific objectives includes examining the sources and components of solid wastes generated, estimating the quantity of solid waste disposed, examine the method of solid waste management, identifying the most common types of diseases and disease vectors associated to solid wastes

and assessing the role of public health department to solid waste management and problems it faces.

2. Study area

2.1 Location of Juba

Juba is the capital of the state of central equatoria and became the interim seat and the capital of the semi-autonomous government of Southern Sudan in 2005 after the signing of the comprehensive peace agreement (CPA). Juba is one of the fastest-growing cities in the world, and is developing very rapidly after the signing of CPA. Juba's diverse community is made up of approximately 250,000 residents that according to the Survey Department, formally occupy over 30,000 plots of land in greater Juba. It is estimated that of this total, 86,000 occupy "squatter" housing that has been dispersed throughout the area. The maximum temperature is 38°C and minimum temperature of 20°C. Rainy season is from April – October. The city is a river port and the southern terminus of traffic along the Nile, properly called the bahr al Jebel section of the White Nile. Before the civil war, Juba was also a transportation hub, with highways connecting it to Kenya, Uganda and the Democratic Republic of Congo. Because of the war, Juba can hardly be called a "Transportation Hub" anymore. Roads and the river harbor are currently not in use due to disrepair. The United Nations and Southern Sudanese government are repairing the roads, but full repair is expected to take many years.

2.2 Land area and population

Juba is located within the southern part of South Sudan. It is situated in the midst of vast expanses of open space, including swamplands and agrarian landscapes. The Jebal Marata mountain range, located west of Juba, provide a picturesque backdrop for the town with its sharp scenic peaks and wide valleys. The Nile River creates a lush greenway that spans into greater Juba and sub diversity of local flora and fauna, creating a rich ecological zone. City officials estimate that Juba proper occupies a 12 kilometer area in diameter from the center of town (approximately 11,300 hectares). Greater Juba, including the surrounding rural lands, encompasses roughly 100 kilometers in diameter. Interviews with officials from each sub-area, supported by field surveys, provided insight into the population estimates for Juba proper as well as demand for land resources for the short and medium-term.

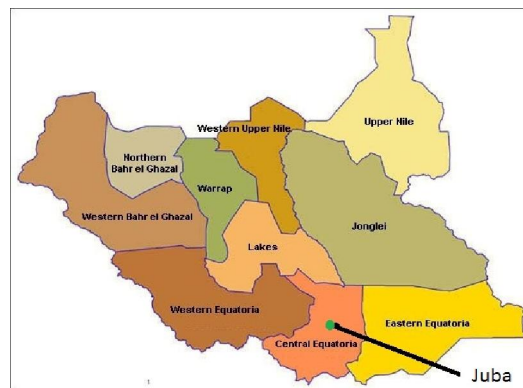


Fig. 1 Map of South Sudan showing location of Juba

2.3 Land Classification

The class system divides greater Juba into three sub-area districts which includes; Juba, Kator and Munuki (Figure 2). These districts operate under three separate administrations. Land classifications are characterized by the plot dimensions, land fees and taxes and the quality and permanence of building materials. Though there were originally four distinct classes, class 4 is being phased out to encourage land ownership and discourage temporary construction.

The land department also presented documents that illustrated the process for registration of land, which occurs through the court system. Though there is no land use zoning within greater Juba, building permits are issued by the Juba administrative unit which reviews development proposals. The review board is comprised of the town council engineer and the public health officer.

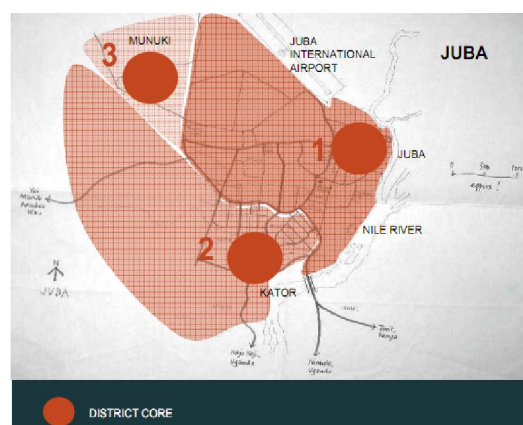


Fig. 2 Three sub-area districts of greater Juba

2.4 Built environment

Juba urban environment was built according to colonial system. According to the ministry of urban

planning in Juba town, the residential areas are classified into classes which are based on types of dwellings, employment status, income level and pattern of life style and were assumed to vary from class to class and public institutions and markets.

The residential category is comprised of four classes. The first class was mainly planned for the senior government and non-governmental officials and some public institutions. The second-class areas were planned for middle and junior officials and some businessmen. Third and fourth class areas were originally planned as temporary native lodging areas. Recently an informal *tukul* zone developed, which were randomly built entirely in local materials mostly occupied by IDPs who came from different states. The town has two main hospitals; Juba teaching hospital and military hospital and some dispensaries and clinics. There are also four main markets within the town, which include Konyokonyo main market, as the major markets that generate large amount of wastes and other markets that generate waste like suk Juba and suk Jebel and other small markets. There is one slaughter house which generates also waste of different types and some primary and secondary schools and university of Juba that generates wastes. There are also public institutions such as churches, mosques, gardens, prisons and stadium. The area also has international airport, which links it to other states and towns.

3. Materials and methods of study

3.1 Data collection

This data was acquired directly from the field involving a combination of methods, namely interviews using questionnaire, face to face interviews and personal observations and secondary data were derived from documentaries (literature reviews), journals, magazine, Internets, thesis, books, government reports, workshops and conference.

3.4 Sampling

In order to investigate solid waste generation in Juba urban area, a stratified random sampling was adopted as the most appropriate method of drawing up the sample size of the population under study. Population taken for this study was 2500 persons. Firstly, the census data on the household population registered according to the residential areas was obtained from the statistics office and used as household sample size. Secondly, the residential areas were listed according to classes. The residential classification was based on type of dwellings (permanent, non-permanent), employment status of the dwellers (senior officials, junior officials, laborers etc) and the income level (high, medium, and low) and pattern of life style, which was assumed to vary from one class to another. In each residential area or class, a

sample size of residential area needed was randomly selected. Two residential areas of each class were visited and observation and interviews were taken into account. On the whole, a sample size of 50 households was randomly selected.

Visits were paid to the following sites: the main dumping site 5 km west of Juba town, the open markets and open-spaces, gutters, street-sides, stream banks, school premises, cemeteries, restaurants and open waste dumps. Data searching visits were organized to the following places state ministry of health, department of public health and environment and Juba teaching hospital for health reports and Statistics office for getting the population census result. The data collected were analyzed using statistical procedures and presented in the form of tables and pie charts for ease understanding of the research findings.

4. Research findings and discussions

4.1 Source and Components of Solid Waste

Observation and questionnaire, indicates that there was very little food waste or garbage discarded in Juba. Much of the solid wastes discarded were plastic bags (nylons), papers, grasses, rags, wooden pieces and automobile remnants. This could be assumed to lack of work and overall lack of awareness among the citizens. The amount and types of solid waste generated and disposed by each class vary according to the standard of living. The sources of this solid waste were mainly from the markets, houses, farms, abattoir and public buildings. According to the research, it was found that 46% of residents said the main source of solid waste was the markets, 20% said its from houses, 16% farms, 14% public buildings and 4% said from the abattoir. This can clearly be illustrated in the table and pie chart shown below:

Table (1) Source of solid wastes in the study area

| Source | Number of Respondents | Percentage (%) |
|----------------------------|-----------------------|----------------|
| Market | 23 | 46 |
| House | 10 | 20 |
| Farm | 8 | 16 |
| Public Buildings | 7 | 14 |
| Abattoir (slaughter House) | 2 | 4 |
| Total | 50 | 100 |

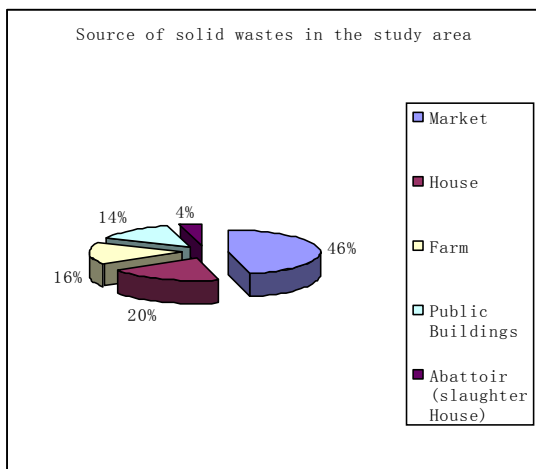


Fig 3 sources of solid waste in Juba town

The components of solid wastes in Juba were mostly domestic solid waste; referred to as household or residential wastes and sometimes termed as “refuse”. These wastes to some extent were similar in all classes of residence studied. It includes; food and vegetable wastes (fruit wastes such as lemon and orange peelings, banana peelings, pumpkin seeds); animal and bird wastes (composed of bones, hoofs, horns, manure, feathers, skin and hides and intestinal wastes; crockery (consists of glass, bottles, tin cans, old plates, charcoal stoves, dishes and cups); wood and grass wastes (include straw and twigs, dry leaves, ashes, charcoal, seed and grass); kitchen and house sweepings (include dust, sand and gravels, clothes and leather wastes, nylon bags, papers, cartoons and textiles). Commercial and market wastes include vegetable wastes, fruit & root wastes, papers, cartoons and nylon bags, animal and bird wastes, ashes, cinder and clinkers, charcoal, dust, grass, reeds, straw and iron scraps, tin and barrel cuttings, plastic and leather cuttings. General community wastes comprise of street, open space and other municipal wastes, like fallen leaves, demolition debris, dead animals, and others. Office and institutional wastes are mainly papers, cartons, cigarette and matchboxes, packaging, cardboards and sweepings. Industrial solid wastes include waste from welding workshops, carpentry workshops cobblers’ stall, like iron scraps, tin and barrel cuttings, wood and saw dust. Hospital wastes comprise of clinical waste, packaging, papers, cartons, plastic bags, bottles, and sweepings. Garden wastes include grass, trimming, and agricultural wastes. During the field investigation of solid waste management, it was generally observed that there was very little food waste discarded in the study area. Questionnaire revealed that about 54% of citizens disposed plastic wastes as their common solid wastes, 18% paper wastes, 8% human wastes, 2% animal wastes, 6% vegetation and 12% metal waste. This is

shown in the below table and pie chart.

Table (2) Components of solid wastes

| Type | Number of Respondents | Percentage (%) |
|--------------|-----------------------|----------------|
| Plastic | 27 | 54 |
| Papers | 9 | 18 |
| Vegetation | 3 | 6 |
| Human | 4 | 8 |
| Animal | 1 | 2 |
| Metals | 6 | 12 |
| Total | 50 | 100 |

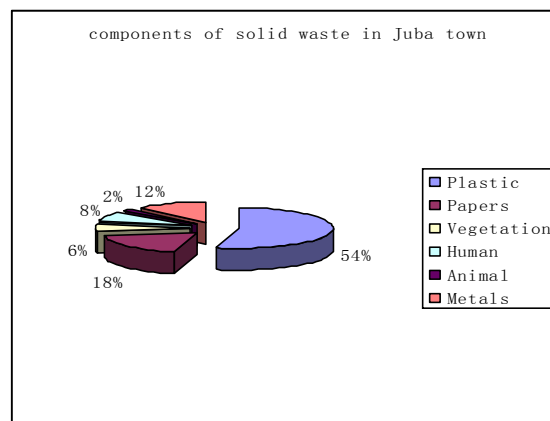


Fig 4 components of solid waste in Juba town

4.2 Quantity of solid waste disposal

To measure the quantity of solid waste disposal in the study area was found difficult due to lack of equipments; but what was done was an estimate of solid waste disposed. According to the research, it was revealed that 80% respondents disposed small amount of solid waste per day about 20 kg on estimate, 16% said they disposed medium (32 kg) of solid waste per and 4% disposed less as illustrated in the table below. Generally questionnaire or interviews revealed that the whole town disposed 40 tons/day.

Table (3) Quantity of solid waste disposed

| Quantity | Number of Respondents | Percentage | Quantity in Kg | Frequency |
|--------------|-----------------------|------------|----------------|------------|
| Large | 2 | 4 | 46 | 98 |
| Medium | 8 | 16 | 38 | 76 |
| Small | 40 | 80 | 26 | 52 |
| Total | 50 | 100 | 100 | 200 |

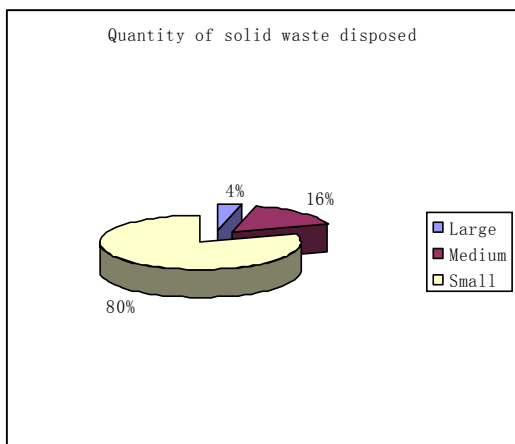


Fig 5 Quantity of solid waste disposed

This was confirmed by mere observations as stated earlier. The amount and quality of waste (including food) consumed or generated by a household depends on the level of income and size of the household. A household with a higher income can afford better quality food that renders much waste. A household with a large number of tender tends to virtually consume all the food leaving very little waste that can no longer be utilized in any conceivable way. The higher the standard of living, the higher the consumption rate and the larger the amount of waste disposed. Countries with higher incomes produce more waste per capita and per employee, and their wastes have higher portions of packaging materials and recyclable wastes (Sandra Cointreau 2006).

An observation of solid waste was made in commercial centers and open markets including food-marketing centers, restaurants, and slaughterhouse and meat markets. The followings were the most commonly observed waste; food and vegetable waste, fruit and root wastes, papers, cartons and nylon bags, animal and bird wastes, ashes, cinder and clinkers, charcoal, dust and grass, iron scraps, tin and barrel cuttings, plastic and leather cutting. General community wastes were observed along the streets, open space and other municipal waste such as fallen trees, dry leaves, dead animals (dogs, rats, cats birds, etc.) construction and demolition debris, litter, trash and clippings and other throwaways. Along the government ministries and public institutions, wastes such as papers, cartons, cigarette and matchboxes, packaging, cardboard and sweepings were observed. In the industrial area mostly around konyokonyo market, waste from welding workshops, general workshops, blacksmith and junk-dealers workshops, and cobbler's stalls, were observed. During the visit to Juba teaching hospital, clinical waste, packaging, papers, cartons and sweeping were also seen. It was generally observed that the largest amount of disposable waste appeared to be ashes, fine

charcoal, sand and gravel, leaves, milk and tomato-paste tins, bottles and crockery, nylon bags and papers. The greatest amount of animal waste was found in the slaughterhouses, meat markets, and restaurants and in the main dump. In the open markets were observed heaps of iron scraps, tin, plastic, barrel and leather cuttings, charcoal and wood, vegetable and fruit wastes. Whereas in the shopping centers were found rags and other textile, cartoons, papers, packaging etc.

4.3 Method of solid waste management

There are several methods of solid waste management but the most commonly applied in Juba were two namely; solid wastes are either burnt on site within the residential area or burnt in the main dump. Questionnaire revealed that 80% households disposed their waste unburned in open space, which spreads randomly around the area as was observed, and 20% claimed that they dumped and burned in open area within the residential area. These can be illustrated in the table shown below.

Table (4) Method of solid waste management

| Methods | Number of respondents | Percentage (%) |
|-----------------------------------|-----------------------|----------------|
| Dumped and unburned in open space | 38 | 76 |
| Dumped and burnt in open space | 12 | 24 |
| Total | 50 | 100 |

Result reveals that, about 46% household disposed waste once per day, 37% twice per day and 17% three times per day. In regards to the unburned dump and burnt wastes, about 62% households said it give bad smell and sight, 28% said it facilitates the propagation of flies and 10% said it attracted scavengers, stinging insects and provided breeding ground for mosquitoes and flies. From observations, heaps of open burning residues composed mainly of ashes, cinders, clinkers, iron scarp, bottles, tins, cans and other unburnable materials continue to grow and scattered. Some of the problems arising from open burning include; air pollutions, health dangers to workers and residents, bad odor and fire hazards. Most of the residents complained of these effects. This method of solid waste management does not suit with the sanitary method of waste management because it poses health problems.

As for disposal of waste, the study revealed that 74% households interviewed discarded their waste randomly off within the residential area, 14% within the house compounds and 12% claimed that they disposed their waste in the dumping site within the residential area and later transported to the main dumping site located 5 km west of the town.. Most

households' lacks public fixed containers, waste are kept in the house compounds, or are immediately disposed indiscriminately off the house premises or at the nearest waste dumps on bare ground where it is left to rot or burnt. Those areas where the wastes are dumped are intensively used as sites for both disposal of waste and for day and night defecation. About 71% household interviewed said they did defecate on these dumps, while 29% households answered no. About 92% households said the waste management system was unsatisfactory while 8% households said it was satisfactory. Those who said the waste management system is satisfactory came from official quarters because these areas are better served by government laborers. All the public health efforts are directed towards proper maintenance of this area occupied by senior government and non-governmental officials.

The study also revealed that about 90% household does not pay for the services of waste management in the area and only 10% households admitted paying the amount for the services of waste management program in the area. However, about 60% of the household expressed their conditional willingness to pay if the services are adequately rendered to them, 22% household said they would pay if they were asked to do so, and 28% said they couldn't simply pay because they cannot afford due to poor standard of living and lack of employment to generate income. At the time of this research, observations revealed that refuse in the main dump were spread all over by the action of wind and other scavenging animals. Animal waste was seen rotting there and they're especially around the slaughterhouse areas. No burial or sanitary landfill was observed. It appears there is an urgent need for relocating the main dumping site which should be done in accordance with the trend of physical horizontal expansion of the area and in the consideration of the topography of the new site, the direction of the prevailing wind, the possibilities of the future expansion of the site and introduction of new disposal methods and accessibility to truck, and manpower. There is no house-to-house collection of solid waste covering all the residential areas but only in some first and second-class areas and commercial areas. The collection by public health department (workers) is directly from any heaps of accumulated residential solid waste within the residential areas and commercial areas. Every households and commercial areas generates solid wastes and the town lacks neither standard refuse containers nor the public refuse containers provided by public health departments.

In Juba urban centers such as Kator, Munuki, Juba central and commercial areas like Konyokonyo, Suk Jebel and Suk Malakiya suffered from problems of malodors, flies, mosquitoes, rats, cockroaches, scorpions, malaria, diarrhea, eye irritation and,

respiratory diseases and many other diseases associated with solid waste were widespread in the areas. Residents attributed this situation to deficiency in solid waste management systems.

4.4 Common Environmental diseases

Some of the more commonly reported occupational health and injury issues in solid waste management includes (Sandra Cointreau 2006):

- Back and joint injuries from lifting heavy waste-filled containers and driving heavy landfill and loading equipment;
- Respiratory illness from ingesting particulates, bio-aerosols, and volatile organics during waste collection, and from working in smoky and dusty conditions at open dumps;
- Infections from direct contact with contaminated material, dog and rodent bites, or eating of waste-fed animals;
- Puncture wounds leading to tetanus, hepatitis, and HIV infection;
- Injuries at dumps due to surface subsidence, underground fires, and slides;
- Headaches and nausea from anoxic conditions where disposal sites have high methane, carbon dioxide, and carbon monoxide concentrations; and
- Lead poisoning from burning of materials with lead-containing batteries, paints, and solders. The common disease in the study area according to public health inspector in Juba town includes: diarrhea, malaria, viral disease, eye diseases and skin diseases. The major causes of these diseases in poor environmental sanitation are improper disposal of refuse and human faeces, inadequate water supply, poor housing and bad food hygiene. Accordingly, about 26% households suffered from diarrhea, 24% household suffered from malaria, 18% from viral disease, 14% from eye disease, 10% from skin disease and 8% from typhoid. The result is shown in the table and chart shown below.

Table (5) Common Environmental diseases

| Disease | Number of respondents | Percentage |
|---------------|-----------------------|------------|
| Diarrhea | 13 | 26 |
| Malaria | 12 | 24 |
| Viral disease | 9 | 18 |
| Eye disease | 7 | 14 |
| Skin disease | 5 | 10 |
| Typhoid | 4 | 8 |
| Total | 50 | 100 |

In Juba, all the households were familiar with the observable environmental disease vectors namely; flies rats, mosquitoes, cockroaches, scorpions, and others. Most of the households observed these disease vectors in their houses, uncollected waste dumps and in

many other places. On observation, flies, mosquitoes and rats were found inside and outside houses, waste heaps around open markets, restaurant, abandoned latrines and open spaces been spattered with excreta and refuse. The study indicates that flies, mosquitoes and rats were prevalent in all residential and commercial areas in Juba, but more is seen in the unclassified areas. It was reported that in the beginning of wet season when all the refuse and faeces are soaked with water, it becomes ideal for insect breeding and the population of flies increases tremendously and disease incidence increases correspondingly.

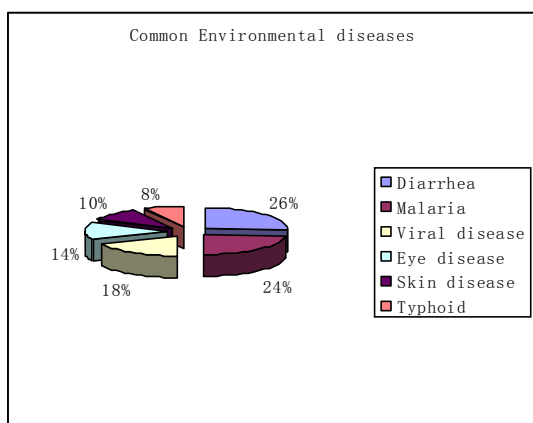


Fig 6 Common environmental diseases in Juba town

The research established a relationship between the amount of solid waste produced by an area and the prevalence of disease vectors in that area. Observation reveals that the more waste an area produces, the more the prevalence of disease vectors, and the higher the disease incidence, provided that the waste remains uncollected long enough for breeding of disease vectors. The population of flies drops during the dry season and when rainfall is heavy. On the whole, 16%households said that these disease vectors breeding in waste dumps became a threat in dry season and 84% said it became nuisance in wet season. This is shown in the following table.

Table (6) Season in which waste becomes a major problem

| Season | Number of respondents | Percentage (%) |
|--------------|-----------------------|----------------|
| Wet | 42 | 84 |
| Dry | 8 | 16 |
| Total | 50 | 100 |

4.5 Role of public health departments to solid waste management

Refuse excreta and defecation in open areas in every hot and dry desert climate does not pose a serious threat to human health as well as the surrounding

environment (provided it is far from community) simply because the sunlight and heat quickly render the waste harmless. Lack of basic infrastructure system particularly within the area where low income group concentrated leads directly to major environmental pollutions problem which affect water, land and air. These hazards in turn pose not only aesthetic but also exposed solid waste worker to significant levels of physical, chemical and biological

The research revealed that 82% household don't receive health education from the public health department which has been observed by poor sanitation practices in the area and only 18% household which are mainly from first and second class areas do receive health education. This is shown in the table below.

Table (7) Role of the public health department in health education

| Health Education Provided by Public Health Department | Number of respondents | Percentage |
|---|-----------------------|------------|
| Yes | 9 | 18 |
| No | 41 | 82 |
| Total | 50 | 100 |

The study also revealed that 36% household said that public health department burned solid waste on-site, 30% said that they collected domestic solid waste, 20% said they transported solid wastes, 14% said they burns solid waste at main dumps and no wastes containers were provided to them. About 12% indicated that management was inefficient, 18% said it was irregular, 24% remarked that it is unsatisfactory and above all 46% of the household accused the public health department of not maintaining hygienic conditions all over the town. This can be illustrated in the table below.

Table (8) Household satisfaction with public health department regarding solid waste management

| Performance | Number of respondents | Percentage |
|---|-----------------------|------------|
| Management is inefficient | 6 | 12 |
| Management system is irregular | 9 | 18 |
| Management system is unsatisfactory | 12 | 24 |
| Public health department does not maintain hygienic condition of the town | 23 | 46 |
| Total | 50 | 100 |

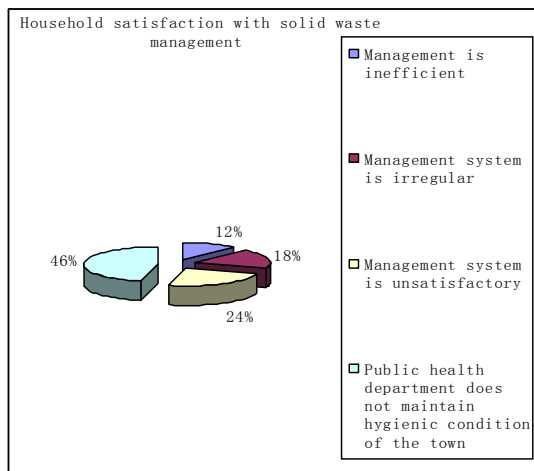


Fig 7 Level of household satisfaction with public health department in regards to SWM

Workers and waste pickers handling solid waste throughout the world are exposed to occupational health and accident risks related to the content of the materials they are handling, emissions from those materials, and the equipment being used (Sandra Cointreau, 2006). The public health employees in Juba town were interviewed to know their working conditions. The research found that most of the waste pickers are young people of age 15 years and old men and women of which most of them are illiterate. Waste pickers complained of the heavy work they do especially during wet season. The workers interviewed enumerate the following employment problems: the job is heavy, nasty and full of health risks especially in the wet season, the salaries are very low and irregular about 300 South Sudanese pounds (SSP) per a month. Facilities and working implements are not enough, there are social problems to waste pickers in regards to their job as dirty and odorous, moral and motivation to work has declined.

4.7 Summary

The town is poorly financed and is unable to generate revenue to adequately pay the public health workers and to purchase refuse trucks, spare parts, equipment and facilitates for refuse storage and collection.

Refuse and excreta are not regularly cleared due to shortages in transport facilities. The public health departments have only few Lorries and refuse tractors which cannot cover the ever-growing bulk of solid waste output in Juba. Apart from that, labor force is inadequate due to acute shortage of funds to be paid for workers. Most of the solid waste workers are street boys and old men which lacks qualified and trained personnel to ensure smooth management and supervision of public health activities. The most and

serious challenging factor was the lack of cooperation from the publics. The unenlightened public thinks that waste management is the sole responsibility of the public health department. Moreover, environmental diseases and their mitigation are still weak due to lack of public health education and enlightenment.

5.0 Conclusion

The study revealed that the amount of solid waste generated varied from one area to another. The quantity of solid waste tended to increase in level of income, activity, changes in eating habits and the widespread use of disposable containers and packages resulting in huge amounts of waste and geographic factors. Observation indicates that the domestic solid waste in all areas surveyed appeared homogenous. The amount of organic waste, were greater than the rest of the waste components observed. The study revealed that solid waste management in Juba town is inefficient and unsatisfactory.

The prevalence of disease and disease-vectors in Juba town is related to the amount of refuse produced and to insanitary management. The more waste an area produce and the more insanitary that area was, the more prevalent the disease and disease vectors were, and consequently the higher the incidences of environmental diseases. Accordingly, problem of solid waste management in Juba will continue to magnify and urban environment will uncontrollably deteriorate unless proper management is taken and the public cooperate with public health department in environmental sanitation of the town.

The following recommendations are suggested for consideration. The public must be enlighten and aware on the impact of solid waste on human and environmental health through various means of communication. External financial assistance is needed to support poor country like South Sudan in their environmental efforts, even though solid waste projects have proven to be more time-consuming to prepare and implement than most urban infrastructure improvements. The following methods of financing solid waste management system should be encouraged such as: general property taxes, separate property taxes and containers charges. Four Rs (Refuse, Reuse, Recycle, and Reduce) should be followed for waste management.

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