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# GEOGRAPHIC FACTORS AND URBAN SOLID WASTE DISPOSAL SYSTEM IN MEIKTILA, MANDALAY REGION


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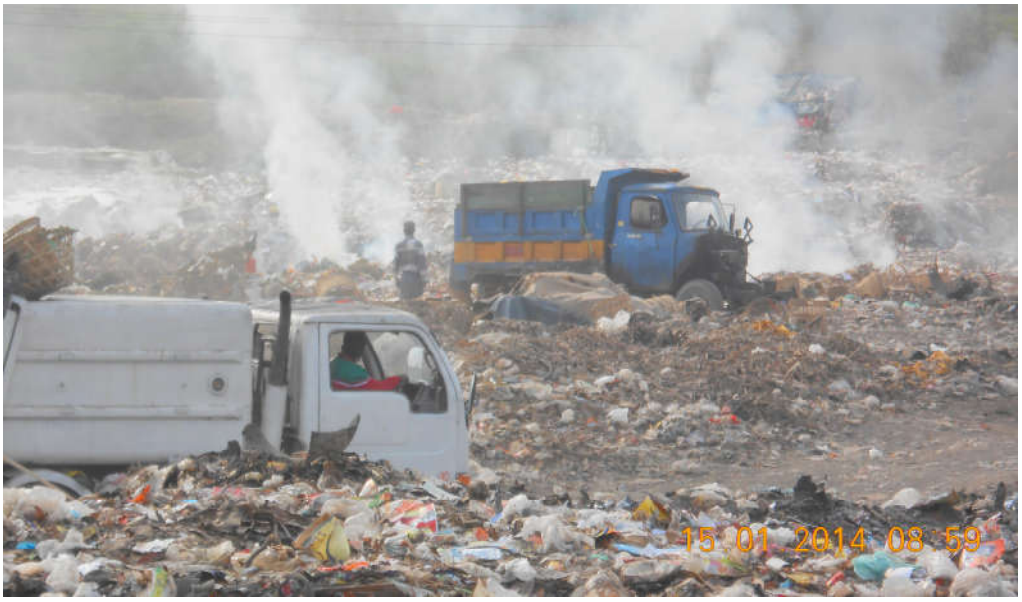


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# GEOGRAPHIC FACTORS AND URBAN SOLID WASTE DISPOSAL SYSTEM IN MEIKTILA, MANDALAY REGION

Thet Khaing [1]

Abstracts

All of the urban areas today, whether large or small, are facing the disposal problems of wastes, both solid and liquid. The larger the urban area and the size of population, the greater are the problems of wastes. Meiktila is one of the largest and most populous towns in Mandalay Region, Central Lowland of Myanmar. It has undulating topography and enjoys tropical dry climate. Uneven topography makes the solid waste collection by garbage trucks more difficult and then it produces disposing the wastes haphazardly in open spaces along the road sides. Thus, open dumps appear throughout the urban area. Number of population is not very significant in disposal system but its concentration is more influential than the physical factors. Indiscriminate disposing of solid waste by the town's residents and commercial activities and improper management on disposal system of the town will produce undesirable results of urban wastes. All stakeholders in the waste stream are responsible for preventing the adverse effects resulted from the undisciplined disposal system of solid wastes.

## INTRODUCTION

Meiktila, located in Central Lowland of Myanmar, is one of the largest and the most populous towns of Mandalay Region. It is also located at the hub of motor roads connecting other large towns and cities of other States and Regions of Myanmar. Being a large town, it has also urban environmental problems like other towns and cities.

Solid waste consists mainly of municipal solid wastes which include all solid wastes that enter the municipal solid waste stream. Disposal is defined as all actions concerned with placing waste and residues in their final resting place.

In a view of physical geography, undulating topography of the study area and its resultant drainage condition are the major influencing factors on collection of solid wastes in the study area. Climatically, the study area has Tropical Steppe Climate with high temperature, scanty rainfall but occasional thunderstorms. Storm water runoff of torrential rain can carry solid wastes scattering throughout the residential area into the drains along the road sides. Then they have been blocked with the solid wastes. Rain water that leached out from the communal dumps along the roads becomes contaminated water and combines with waste water from residential areas. Due to the blockage of the solid wastes in the drains, over bank flow of contaminated

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waste water occurs along the roads in residential areas. Lithology and soil types of the study area have no direct effects to disposal of solid wastes but indirect to wastewater.

As in social factors, total number of population has less significant influence on solid waste disposal system than population density. Moreover, public awareness about the urban waste and their participation are the most fundamental to the proper waste management system.

Athough this paper cannot be regarded as a complete one, it will probably provide a large number of information to develop a good plan to manage the urban solid waste in Meiktila as well as other large urban areas.

**Aims and Objectives**

This research paper aims to know the relations between geographic factors and urban solid waste disposal system. Major objectives are to find out the facts to be taken into account in urban waste management of the town and to provide the geographic factors in developing the sustainable Integrated Urban Solid Waste Management System in either the study area or other towns or cities.

**1. Physical Geographic Factors and Urban Solid Waste Disposal System**

Meiktila is situated in Central Low Land of Myanmar. It is the largest urban area of Meiktila District. It is located in the western central part of Mandalay Region. The town is located between 20°50'37"N and 20°55'05"N latitudes and between 95°49'06" E and 95°54'11"E longitudes. Meiktila has total area of 7.12 square miles including 4.51 square miles of land area. The town has star shape (Map 1). The town comprises fourteen wards (Map 2). Shape of the town will be a problem in collection and transportation of solid waste and selection of final dump site ore sites.

Generally, Meiktila lies in Lowland of Central Myanmar. Undulating relief, however, covers Meiktila and its surrounding areas. Land surface of the town stands a little higher in the west, north, southwest and southeast while it is found to be relatively level in the east and northeast. Generally, Meiktila stands at an average elevation of 750 feet (228.6 m) above sea level. The highest point of the town is the Shwemyintin pagoda (859ft. or 261.8 m) in the southeast. Northern and northwestern part of the town reaches to a height above 850 ft. (or 259 m). The land surface slopes down toward the Meiktila Lake and then toward the east and southeast. The lowest parts of the town is at an elevation below 750 feet. (Map 3)

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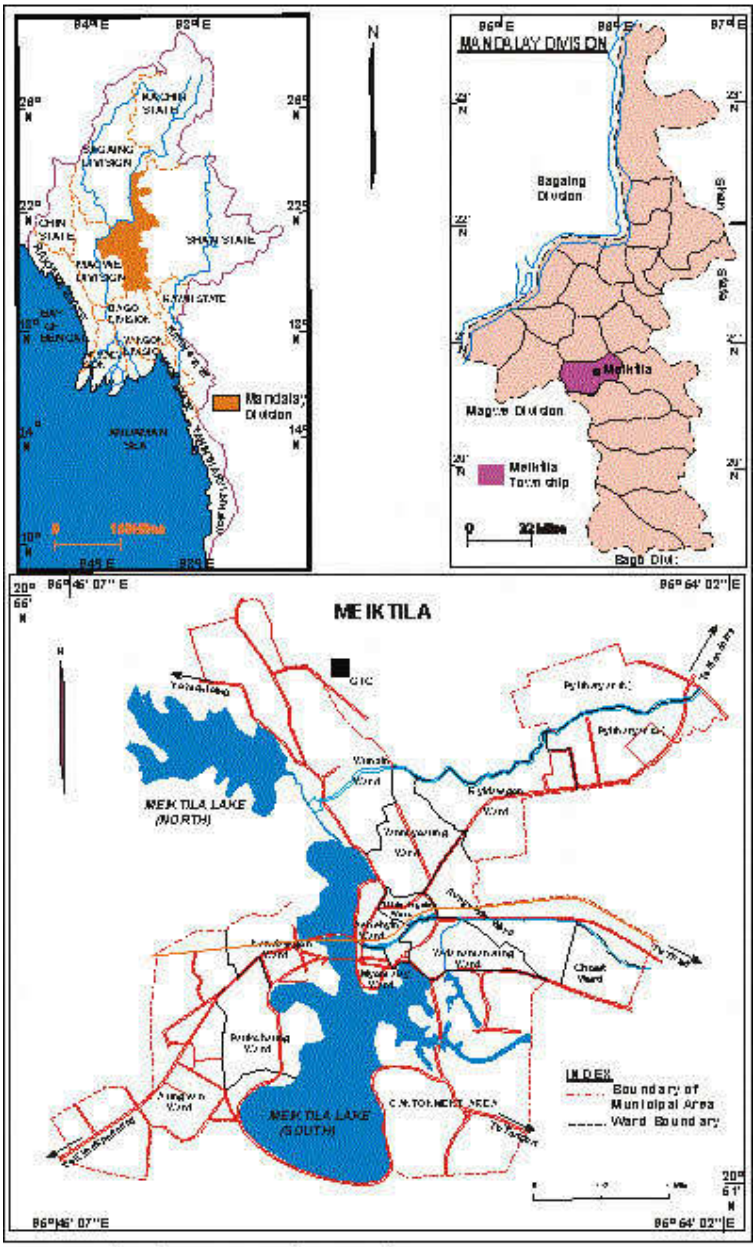
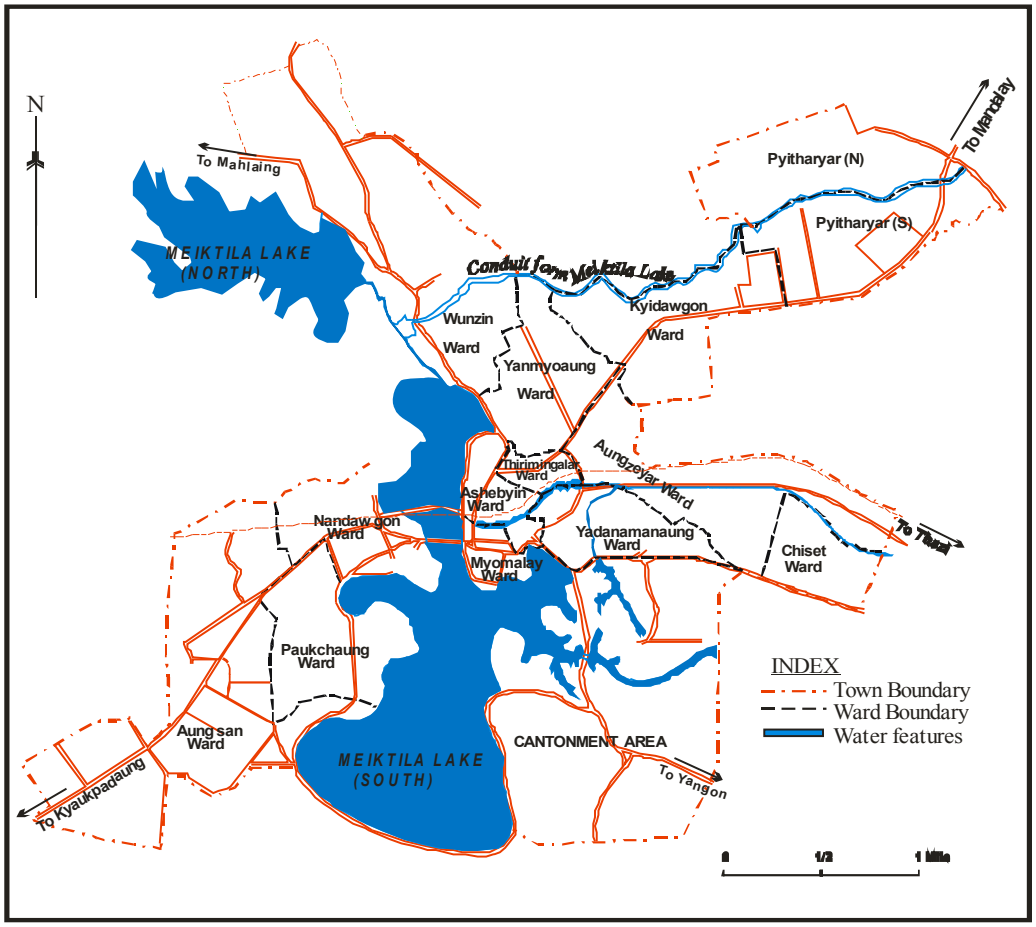
Map(1) Location Map of Meiktila




Source: Department of Geography, Meiktila University

## Map(2) Wards in Meiktila




Source: Field observation in 2010 and 2011

**Table (1.1) Names of wards and their extents in Meiktila**

| No. | Name of Wards | Area (Square Mile) |
|---|---|---|
| 1 | Aungsan | 0.84 |
| 2 | Paukchung | 0.35 |
| 3 | Nandawgon | 0.35 |
| 4 | Myomalay | 0.11 |
| 5 | Ashebyin | 0.17 |
| 6 | Yandanamanaung | 0.13 |
| 7 | Thirimingalar | 0.1 |
| 8 | Wunzin | 0.47 |
| 9 | Yanmyoaung | 0.48 |
| 10 | Kyidawgon | 0.47 |
| 11 | Aungzeyar | 0.32 |
| 12 | Chiset | 0.22 |
| 13 | Pyithayar (South) | 0.28 |
| 14 | Pyithayar (Noth) | 0.22 |
| | Total | 4.51 |

Source: Land Records Department, Meiktila

Uneven topography of the town directly influences on collection of solid wastes. Steep slopes in Wunzin Ward (except along the Meiktila - Myingyan Road) and some parts of Thirimingalar and Aungzeyar Wards (except along the Yangon - Mandalay Highway) hinder the accessibility of garbage trucks to collect the solid waste regularly from the residential areas.

Generally, it can be said that Meiktila has a good drainage condition due to its undulating relief. Except Pyithayar (S), Pyithayar (N), Chiset ward, western most part of Aungsan ward, and western most part of Yanmyoaung ward, all wards have uneven relief. Therefore, surface run-off of rainwater can readily flow into the lower level. (Map 3)

The largest water body is Meiktila Lake, major fresh water source, which lies at the center of the town. It is located at an elevation below 750 feet above sea level.

Sithu Canal, formerly a distributary canal of Meiktila Lake, is now used as wastewater drainage canal. This canal is the only one main canal to dispose polluted water from downtown area of the town. Most of the sewage ditches in downtown area connect to this canal. Although it was designated as wastewater canal, urban residents along the canal dispose off their solid wastes haphazardly into the canal or along the banks of it. Thus, banks of the canal looks like a road paved with refuse. Moreover, some residents along the ditch, especially along the lower reach, use the water for washing clothes and bathing without any treatment. (Photo 1)

In Wunzin Ward, there is a conduit (called Kaukkwe taw Myaung) from which water from Meiktila Lake (N) spill over throughout the year. Residents in northern part of Wunzin Ward, Yanmyoaung Ward and Pyithayar (N) and (S) use the water of this canal for washing and bathing and also discard their refuse into it. (Photo 2)

Other town drains are the road side channels of the urban area. Except some parts of downtown area, almost all of the road side channels are earthen drains of various sizes and unsystematic. Some wards have no road side channels. Most of the road side channels are also blocked with solid waste. (Photo 3)

Climatically, locating in Dry Zone of Central Myanmar Meiktila enjoys Tropical Steppe Climate (BSh). By the records of temperatures for 55 years period (from 1954 to 2008), the town receives average mean annual temperature of about 80.74°F, mean maximum temperatures of 93.29 °F and minimum of 67.72°F. During the same period, average total annual rainfall amounted to 32.5 inches. In summer season, high temperature can make the solid waste in an open dump very dry and flammable. In hot, windy days, they are flown into the air. In rainy season, rain water percolating through the open dump can contaminate the surface runoff of rain water. If it is heavy rain, surface runoff can remove the solid wastes on the land surface on which they pass through and block the road side channels with them. Thus, flooding of dirty water will occur on the streets and yards of households in low lying areas (Photo 3). The rainy days can disturb the daily tasks of waste collection by the garbage trucks .Besides, in the day after the rainy day, weight added problem will occur due to seepage of rainwater into the solid waste.

In Meiktila, major soil types include red brown savanna soil and crushed stone soil in more elevated areas, meadow soil and meadow solonez soil in flat lowlands and alluvium along the streams and around the Meiktia Lake. In areas with poor drainage condition, due to impermeability of meadow soils, piles of solid wastes and water logged condition combined to produce more adverse impact on environment than the areas of good drainage.

The natural vegetation, as a rule, is related to the climate and soil type. As being situated in Central Dry Zone with low rainfall, Meiktila has natural vegetation of xerophytic species. They cannot create some solid waste disposal problems but can

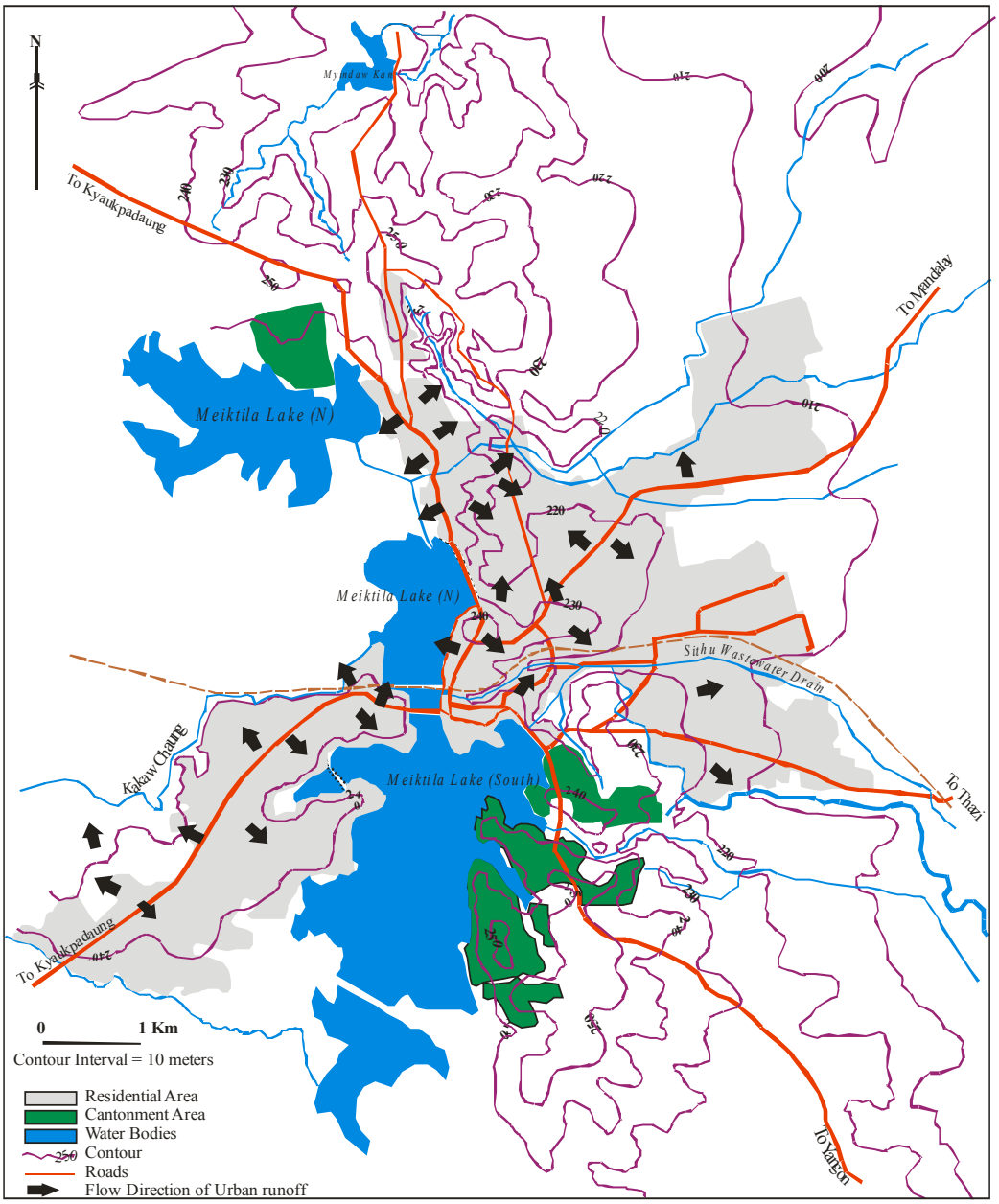
produce the fluctuation of the amount of yard waste collection by seasons. Open burning of the yard waste can be seen throughout the urban area. Except some wards in downtown area, large amount of yard waste occurs in all wards. Up to now collection and disposal problems of yard waste cannot be solved by the municipal department.

Photo(1) Disposing of Solid Waste into the Sithu Canal

Photo(2) Disposing of Solid Waste into the Conduit from Meiktila Lake (N)


Photo(3) Flooding of gray water due to blockage of solid waste in road side channel

**Map(3) Relief and Drainage of Meiktila and Its Environment**




Source: UTM Map No. 2095- 13 and Field Observation (2011)

**2. Social Geographic Factors and Urban Solid Waste Disposal System**

In 2013, total population of the town was (94,969) persons including (42,959) persons of male and (52,010) persons of female. In general, the number of population can directly relate to amount of waste generation. According to solid waste quantification (2010 to 2013), average waste generation rate of urban residents was 0.343 kg/ capita/ day. Thus, total estimated generation rate of household waste was 32,574.4 kg (ca. 32.5 tons) per day. By comparing the number of male and female population, the gender ratio was 100:121 in 2013. In the field records of solid waste disposing along the routes of garbage trucks (2013), the proportion of female was 70 to 80 persons in every 100 persons who are directly involving in disposing activities.

Without regard to number of population, the wards in downtown area (especially those lie in CBD area) generate large amount of solid waste (vehicle-survey on garbage trucks of municipal department). Ashebyin Ward and Thirimingalar Ward, which are in CBD area of the town, usually generate larger amount of solid waste than the Words of suburb area.

Moreover, in some parts of Yanmyoaung Ward , parts of Paukchaung Ward and parts of Aungsan Ward, where there are many lodging activities for university students, generation of large amount of solid waste occur during school period( June to March).

Another more important factor is concentration of families in residential area. In 2013, the total population was **(**94,969) persons formed (18,862) families. As compared to the number of population and the number of families they constitute, the average family size was 5 persons per family.

Among the fourteen wards of Meiktila, the largest number of families (2,476) occurred in Aungsan Ward and the smallest number (550) in Chizet Ward (2013). The concentration of families in an area will be more important in storage and collection of solid waste and wastewater than the total number of families.

If families will exist in concentration, there are less open spaces for dumpsites. Thus, almost all of the solid wastes they generate can be stored in a few number of dump sites and can be efficiently collected by the waste collectors and garbage trucks within a short duration and in readily accessible area. Among the fourteen Wards of the study area, Thirimingalar and Myomalay Wards have highest

concentration of families per unit area. In the wards with less concentration of families, the small heaps of solid waste are widely scattered in open spaces, roadsides and other unused lands. And then a large number of scattered small dumpsites occur. A garbage truck collects the solid waste in a long distance with longer time duration. The result of field observation is shown in the following table.

| | Ward of High pop; Density | Ward of Low pop; Density |
|---|---|---|
| Loading capacity & number of labours | 2 tons/ 5 collectors | 2 tons/ 5 collectors |
| Length of collecting route | 2 Miles | 3 to 4 miles |
| Duration for solid waste collection | 1.5 hours | 2 hours |
| Fuel consumption | 0.75 gallon | 1 gallon |
| Actual collected load | 2 tons and above | 1.5 to 2 tons |
| Estimated cost for 1 ton of solid waste | About 5000 Kyats/ton | Above 6000 kyats /ton |

**Source: Field survey from 2011 to 2013**

**3. Current Urban Solid Waste Disposal System in Meiktila**

There are five functional elements in disposal system-

(1) Waste Generation from various sources such as households, commercial activities, municipal services and etc..

| Source of generation | Total tonnage per day (Wet Weg) | Collection by garbage trucks | Total tonnage per day (Wet Weg) |
|---|---|---|---|
| Households + lodging | 32.6 | 2.5 tons x 4 Trucks x 2 Routes<br>1.5 tons x 2 Trucks x 2 routes | 20<br>6 |
| Municipal Services | 7.5 | 3 tons x1 truck x 2 ply<br>1.5 tons x 1truck x 2 | 6<br>3 |
| Food Shops | 3.7 | 1.5 tons x 1 Trucks x 2 routes | *3 |
| | 43.8 | | 38 |

Balance = 43.8 tons- 38 tons = 5.8 tons which cannot be collected by garbage trucks regularly.

*** Some food shops and economic activities dispose off their solid waste using their own vehicles.**

(2) Storage as in primary storage and secondary storage. (Photo 7 & 8)

(3) Collection by garbage trucks of municipal department and scavengers. (Photo 9&10)

(4) Transport only by garbage trucks of municipal department and

(5) Disposing at final dumpsite and indiscriminate disposing. (Photo 11& 12)

Photo (7) Primary Storage

Photo (8) Secondary Storage

Photo(9) Collection by Garbage Truck

Photo(10) Collection by Scavenger

Photo(11) Disposing at Final Damp Site

Photo(12) Indiscriminate Disposal

All these functions in the study area have improper management. The current disposal system of the study area is simplified by the following figure.

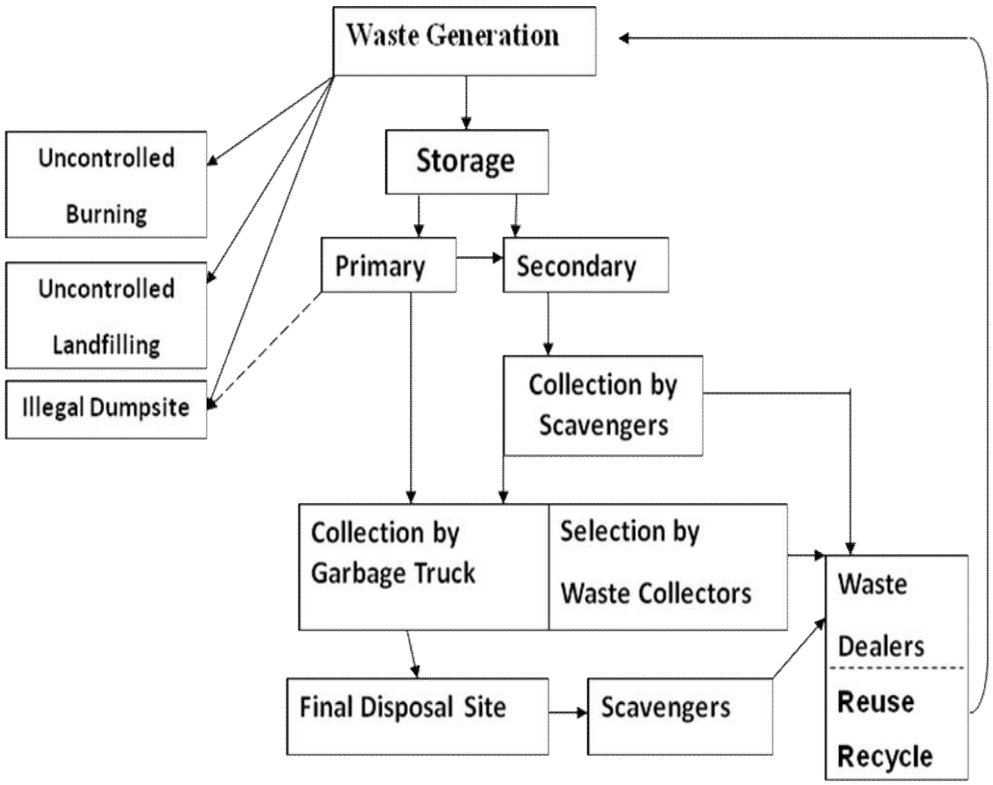



Figure (4.1) Current Disposal System in Meiktila

**4. Conclusion and Suggestions**

Meiktila is located on undulating relief with good drainage conditions which is an obstacle to solid waste collection system. To overcome this problem there should be communal storage facilities or controlled dump for solid waste. To transfer the waste from these storage facilities well designed vehicles such as wheeled bins, hand carts or animal carts should be used.

Spreading of solid waste from a dump can be caused by wind. Then the windblown waste will produce eyesore to immediate environment. When they are carried by surface runoff water and deposited into waste water channels, they can block the channels. Therefore communal dumps have to be controlled as a satisfactory storage.

Although physical geographic factors can be overcome by the human innovations, social factors such as public participation and development of public awareness are more important than numerical factors.

In some of primary storage containers such as plastic bags, old bucket and baskets are so-called containers. They are partially broken and leakage of dirty liquid from the solid waste directly expose to waste collectors. These unsatisfactory storage containers have to be replaced with a well conditioned one. Satisfactory storage containers can reduce the direct contact of waste collectors with hazardous waste and non hazardous solid or liquid waste.

In the study area, all the secondary storage facilities are open communal dumps. Solid waste from these dumps can be spread out by scavengers and stray dogs over the road side and street surface. Although some concrete bankers were constructed at the dump sites, most people have not put their solid waste into the bankers. Instead, they left the waste beside or at some distance from the bankers. Based on population factors, there should be establishment of storage facilities in residential areas.

In collection system, sufficient labour force (waste collectors), effective collecting equipments, efficient transferring and transporting vehicles are required. From sanitation point of view, the waste collectors should be well equipped with some protections to handle the solid waste.

The scavengers play an important role in collection of recyclable waste. But their activities to spread the solid waste out of a dump site must be prohibited. Like waste collectors, they should not handle the waste without any protections.

To solve the solid waste disposal problems facing in the study area, the solid waste coming out from various sources must be managed through a number of activities such as waste prevention, recycling, compositing, controlled burning or landfilling. Combining of these activities is referred to as “Integrated Solid Waste Management”. Thus, an Integrated Solid Waste Management Programme (ISWMP) must necessarily be developed in Meiktila by carrying a more complete and fruitful research as further study. All of the urban residents or urban polluters are responsible for development of this programme.

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