

Planning Strategies for Municipal Solid Waste Management in the City of Hassan, Karnataka

KRISHNE GOWDA

Director and Professor of Urban & Regional Planning
Institute of Development Studies
University of Mysore, Manasagangotri
Mysore-570 006, India.

SRIDHARA M. V

Professor
561, P&T Block
10th Cross, Kuvempu Nagar
Mysore-570 023, India.

CHANDRASHEKAR M. N

Professor and Dean
SJB School of Architecture & Planning
Kengeri,
Bangalore- 560 060, INDIA.

Abstract: The growth and demographic changes occurring in Indian cities are posing a serious challenge to urban local authorities. The increase in per capita income and the concomitant industrial and service activities have resulted in a proportionate increase in consumption and consequently, in the quantum and complexity of the composition of solid waste generated. Hassan city had a population of 155,006 as per the 2011 census. The City municipal Area is 37.57 sq. km, implying a population density of 8550 persons per sq. km in 2011. Hassan produces over 61.71 tonnes of solid waste per day and the Municipal Administration is rather inadequate in managing the disposal of this amount of solid waste generated. The urban planning approach is lacking in perspectives about several socio-economic aspects of solid waste systems; thereby the problems of inefficiency and ineffectiveness of the system remain inadequately addressed. Proper management of solid wastes is an integral part of any attempt at upgrading environmental quality. Keeping this in view, the authors describes the existing situation and identify the shortcomings in various aspects of Solid Waste Management and proposes feasible planning strategies which will make for a cleaner and more aesthetic city, reducing environmental pollution and protecting the quality of groundwater and land resources in the city of Hassan.

Keywords: Solid waste management, environmental quality, Municipal Administration, waste buyers, health hazards, indiscriminate dumping.

I. INTRODUCTION

The economic growth and demographic changes noticeable in Indian cities are posing a serious challenge to urban local authorities. By the year 2020, Indian urban centers will witness a huge increase in population. With the rapidly increasing urban population, the requirement for infrastructure and services diversifies and increases manifold. The increase in per capita income and the concomitant industrial and service activities have resulted in a proportionate increase in consumption and consequently, in the quantum and complexity of the composition of solid waste generated. In future, the urban waste generation is predicted to increase substantially as per capita Gross National Product increases. Solid waste collection and disposal is a service, which needs to be adequately provided to ensure an urban environment complementary to the health and well-being and also improving the productivity of residents.

Proper management of solid wastes is an integral part of any attempt at upgrading environmental quality. Keeping this in view, the authors describe the existing state of affairs and identify the shortcomings at various levels of Municipal Solid Waste Management and propose planning tweaks which

will contribute to a cleaner and aesthetically improved city of Hassan. The city of Hassan which is one of the medium size cities in India with increasing urban population, there is a growing volume of domestic waste caused very much by changes in the 'way of life'. This paper is limited to solid wastes from houses, streets and public places, shops and offices.

II. THE BACKGROUND OF THE STUDY AREA: Hassan City

Hassan is located almost at the Centre of the South Indian Peninsula, nearer the western coast at 13° 13' 3" north latitude and 17° 9' east longitude at an elevation of about 945 meters above mean sea level in the heart of *semi-malnad*. It is a picturesque, quiet and peaceful city. The popular belief is that the place is called Hassan after the goddess *Hasan-amma* or *Hasanamba*, the presiding deity of the local Hasanamba temple situated in the old town area. Hasanamma or Hasanamba means, in Kannada, a smiling mother or goddess (Mysore State Gazetteer, Hassan District, 1971, p. 1). The colloquial name has been corrupted during the British influence in the administration of the erstwhile Mysore State.

Topographically, the city is situated in the Yagachi Basin on a smooth ridge sloping to the east, south and

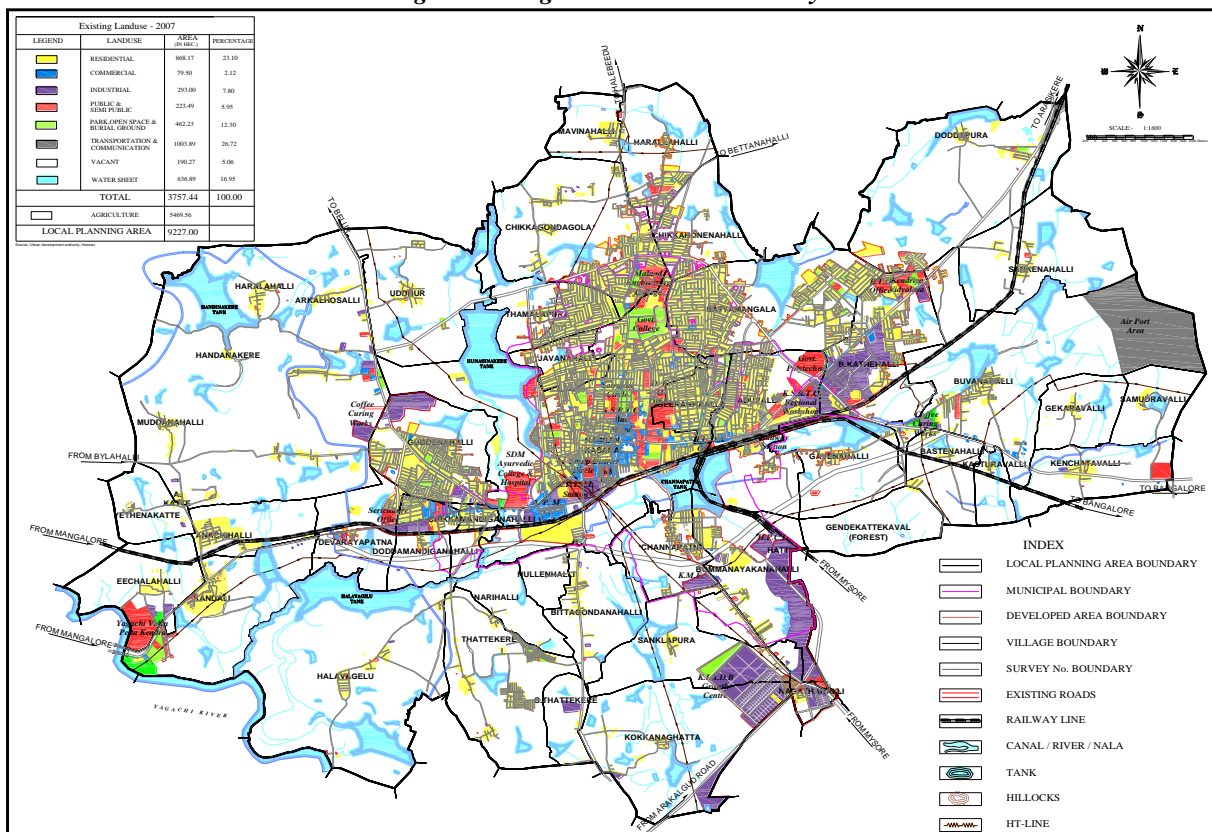
west and also with a vast expanse of gently undulating plain. It is surrounded by Hunasinakere with its water spread and wet lands to the west and Channapatna tank and wet lands to the south. The river course of Yagachi-Hemavathi is about 2 km towards south of Hassan city. The city is 185 kms west of Bangalore and 270 km east of Mangalore. Hassan is the base for the surrounding places of tourist interest, namely Belur, Halebid and Shravanbelagola. It was originally agro-based; and now has changed to a tertiary activity oriented city with predominance of commercial, administrative and educational services. The city is well connected to the neighbouring cities of Chikmagalur, Tumkur, Mysore and Arsikere and also to Bangalore.

The city of Hassan falls under the temperate semi-arid region. April is generally the hottest month with the mean daily maximum temperature of 33.5^o celsius and the mean daily minimum at 19.7^o celsius. Hassan is well known for its equable and salubrious climate. The relative humidity in Hassan is generally high in the southwest monsoon season and post monsoon seasons. The average rainfall of Hassan is around 900 mm. The rainfall is more from June to September (with the maximum rainfall occurring during

September), June and August are the rainiest months. It is observed in recent times that the climate of Hassan has changed and there prevails a general opinion that Hassan climate no more shows its salubrious character. It is necessary to improve the climate of the city by controlling encroachment and expanding the green areas.

Much of the early development of the city has taken place on the northern side of old Bangalore-Mangalore road (National Highway No. 48) which is on the northern side of Channapatna tank and the wet lands. The developments along the ridges running north-south with the old Bangalore-Mangalore road and railway line running east-west, present the 'open palm' pattern for the old town. Tanks and wet lands on the western and eastern sides of the old town had led to the growth of the town as ribbon development along Mangalore road, Belur road, Salagame road and Arsikere road. The total expanse of the LPA including the city comes to 37.57 sq. kms. Additionally there is 54.70 sq. kms of agricultural land. Industries have been established at the periphery of the Municipal limits along Arsikere road, Sakleshpura road and Belur road.

Fig. 1 Existing Landuse in Hassan City



Source: Hassan Development Authority (Compiled by authors)

When it comes to surface drainage, there are nearly 5 to 6 tanks, both small and large, within or just outside the city of Hassan. Important are Devikere and Hunasinakere tanks. At present, some are purely

ornamental, but most of them are irrigational tanks providing varying degrees of support for wet land cultivation. It is also to be noted that with the phenomenal increase in population and the

development of new suburbs, many tanks which at one time were away from the urban influence, have now become dumpsites for city garbage and niche for sewage disposal. This has greatly added to the mosquito menace.

Storm water drains, large and small, are found in all parts of the city and many of them also carry wastewater from domestic as well as public taps. While they were built to drain the rush of rainwater they are inefficient regarding disposal of wastewater from houses. The gradient in many cases is not enough for smooth flow of water, nor to flush away the debris. This is made worse by the indiscriminate throwing of rubbish in to the drains and the natural accumulation of silt over months and possibly years. Water stagnates in many of these drains, and is a common roadside blight.

Hassan had a population of 155,006 as per 2011 the census, recorded the highest growth of 34.6 percent during the period of 1991-2001. The City municipal Area is 26.5 sq. km, working out to a population density of 8550 persons per sq. km in 2011.

The city has been divided into 35 administrative divisions called 'wards' to facilitate the administration of providing municipal services. An

analysis of the various components of municipal services at the ward level is very useful for understanding about civic administration.

Hassan has a radial network of roads and all along the roadsides both residential and commercial activities have developed in a haphazard manner. The village settlements and other constructions remain spread and almost unchanged in the periphery of the city. Spatial expansion of the city has impacted on the environment by causing loss of agricultural land and increasing the built up area during the last few decades.

Water bodies account for more than 10 percent of total land providing scope for beautification of Hunasinakere area. Hassan city is a commercial centre catering to the needs of surrounding areas, but the allocation of land under commercial use is less as compared to other types of land use. Land allocated for the public facilities is also negligible and therefore, it is necessary to study the existing land use carefully and propose suitable changes in land use. The existing land use data shows that the city lacks civic amenities such as parks and playgrounds (see Table 1). The city needs adequate lung spaces. There is no playground for use by general public.

Table 1. Existing Land use pattern in Hassan City

Sl. No	Land Use	Area in Ha	% of total developed area
1	Residential	868.17	23.10
2	Commercial	79.50	2.12
3	Industrial	293.00	7.80
4	Public and Semi Public	223.49	5.95
5	Parks and Open Spaces	462.23	12.30
6	Public utilities	10.91	3.73
7	Transport and Communication	1003.80	26.72
8	Vacant land	190.27	5.06
9	Water bodies	636.80	16.95
	Total developed area	3757.44	100.00
10	Agriculture	5469.56	
	Total Local Planning Area	9227.00	

Source: Hassan Urban Development Authority, Hassan.

III. PRESENT SCENARIO OF HASSAN CITY

The abnormal growth of the city with reference to both area and population has created problems of scarcity regarding physical and social infrastructure and has resulted in higher per capita cost for improvement and maintenance of civic amenities. Squeezing of population in the congested areas, indiscriminate destruction of greenery, urban sprawl, disorderly and large-scale fringe development, are the

problems to be urgently tackled. Pressure on land has become increased and has given rise to other problems such as housing, traffic, slums, municipal solid waste management etc. According to estimates there are 32 slums in Hassan as of 2011, of which 25 are notified which are home to 6779 households. The total population living in slums is 29,144. Thus, a significant percentage of the city population is found to be living in slums. It cannot be denied that

considerable efforts are being made to provide shelter to the urban poor. In spite of this the number of slums and slum households are increasing every year.

The population size, growth rate and distribution have significantly affected the environment of the city. The impact of population on environment is primarily through the use of natural resources, their growing scarcity and production of wastes, all caused by increased economic development, incomes and consumption. The major form of environmental stress in the city is loss of biodiversity and shrinking of water bodies and availability of potable water and air pollution and waste generation. The major environmental problems arising from the process of urban growth are increasing pollution levels due to concentrated discharge of residential wastes, i.e. gaseous, liquid and solid wastes, into the environment and destruction of the fragile urban ecosystem.

IV. INADEQUACY OF UTILITIES AND SERVICES

The quality of life in Hassan and its liveability depend to a great extent on the adequacy of civic amenities, municipal services and community facilities, both quantitative and qualitative.

Road Network: The Municipal council maintains about 139.16 km length of different types of roads and lanes. The national highway passes through the city for a length of 1.8 km and three state highways for a length of 2 km running through the city. About 30 percent of the total road length has bituminous surface, 28.20 percent are Water Based Macadam (WBM), (roads compacted with broken stones and mud without asphalt surfacing) 40.8 percent are earthen roads and the remaining 0.33 percent are cement concrete road. The street pattern is narrow and does not facilitate any alternate route for circulation. Lack of adequate parking space in the commercial area leads to roadside parking of vehicles in the markets and other commercial areas which causing traffic problems in the city. The city has an internal road network density of 7.96 km per sq. km with a total road length of 211 km.

The main issues to be addressed concern with the poor surface conditions, not having proper drainage, poorly maintained earthen shoulders and foot paths, lack of culverts and storm water drains to lead off the rain storms. Poor surface conditions of the existing roads, not having sufficient road side drains, poor maintenance of footpaths.

Water Supply: The main source of water supply to the city is Hemavathi and Yagachi rivers. The quantity of water supplied to the city from both the water works is approximately 18.9 million litres daily. The per capita supplied to Hassan is only 121 litres per day. There are 14 overhead tanks and one ground level service reservoir located in the city.

Approximately 98 percent of the city is covered by piped water supply and the remaining 2 percent is covered by public hand pumps. The total length of water supply pipes is 100 km. There are 16,063 residential and 442 commercial house service connections for water supply.

Deficient Sewerage and Drainage System: Sewage has been simply let out into the existing valleys and streams, without treatment. The total length of the underground drainage system is 70 km. This system was laid some 25 years ago. The sewage treatment tank is located on 12 hectares of land situated at a distance of 4 km from the city, on the Gorur road. The water from the treatment tank is used for irrigating the surrounding agricultural fields. The sludge is auctioned and used as manure. Nearly 70 percent of the city is covered by underground drainage system while the other planned colonies have septic tanks. The slums have no toilet facilities. There are 10 public toilet and 3 pay and use toilets for the entire city. There are no low cost sanitation units in the city.

Underground drainage system was provided to the town in the year 1959. This mainly covers the old town area up to an extent of covering 20 wards. The total sewer length covering 20 wards is about 33.70 km and has around 620 manholes. Though a major part of the city has underground sewers, there are many sections which are private layouts. In such areas, the entire sewage flows into the natural drainage channels which are neither lined nor properly drained. Most of the slum dwellers are throwing waste into these open drains and they are highly polluted.

The storm water outlet points of the city are towards the south of Channapatna tank and towards the southwest into the Hunasinakere tank. Both the tanks have channels leading outside the city. Ninety percent of the roads have surface drains.

Health and Hygiene: Health facilities in Hassan city include government, private, cooperative and mission run hospitals. There are 21 major hospitals and nursing homes in the city. Apart from these the city is equipped with a number of small clinics which cater to the needs of city. One of the problems faced by these hospitals is that the hospital waste is mixed with municipal waste, which is a bad practice and may lead to epidemics. Hospital wastes are required to be collected separately and transported to a different location and burnt, preferably in an incinerator.

Socio-Economic Conditions: The economy of the city mainly consists of the working of good marketing and storage facilities for forest wealth and plantation crops. Hassan is a city sustained by service-cum-trade and commerce-cum-industry. It is an educational centre consisting of several schools and colleges and even a university centre and a space

science centre. In recent times, inception of a number of industries based on minerals and live stocks, coffee curing works etc. have given the city an industrial dimension. Pilgrimage and tourist centres in the district contribute significantly to the city economy. There is a continuous flow of traffic into the city as a result of Hassan-Mangalore railway and other communication entities. The city has also gained importance in religious, social and cultural spheres. The growing city of Hassan is very much in need of adequate housing, drinking water supply, transportation facilities and other amenities including garbage clearance which are quite insufficient even for the present population.

V. SWM: Planning and Aesthetic Problems

A major form of environmental stress in the city of Hassan is loss of biodiversity and water and air pollution and increasing waste generation. The main issues arising from the process of urban development are increasing pollution levels due to proliferating discharge of municipal wastes, i.e., gaseous, liquid and solid wastes into the environment and destruction of the fragile urban ecosystem and nearby water bodies.

Hassan produces over 61.71 tonnes of solid waste per day and the Municipal Administration is inadequate in managing the disposal of this amount of solid waste generated. It is estimated that the per capita generation of solid waste works out to 0.378 kg/day with a population of 155,006 in 2011. The solid waste generated in slums is proportionately less because the consumption levels of slum people are far lower than that of the generality of people. The obnoxious practice of disposing of the garbage in the city by burning of the garbage heaps has to be put an end to. The present municipal solid waste disposal arrangements, consequently, cause air and water pollution posing a very serious threat to the health of citizens in the city. Although active steps are being taken in the city, enormous amount of work as well as planning still requires to be done.

The reason for spilling of garbage all round in the city and indiscriminate dumping of garbage by the 'pourakarmikas' in some vacant places can be attributed to lack of specific and methodically managed garbage dumping yards in the city. The only dumping yard behind the City Municipal Council is now over filled and people residing near this area had once chased the 'pourakarmikas' and threatened them with dire consequences if they continued to dump garbage there. This resulted in indiscriminate dumping of garbage in many vacant places in and around the city (see Plate 1).



Plate 1: Existing dumping yard attached to the main city

Due to the growing 'use and throw culture', the ever increasing volumes of solid wastes have outstripped nature's pace and ability to assimilate them and the capacity of city and municipal authorities to collect, convey and dispose of them safely and effectively. The habit of throwing wastes on the streets and/or drains was more prevalent in case of restaurants and eateries even through the Municipal Council have placed bins near their establishments. Clogging of drains due to wastes thrown is a common occurrence in Hassan leading to stagnation of water and mosquito breeding in various localities (see Plate 2). In many cases, it was observed that such wastes were either thrown on streets/drains or on public/private open spaces resulting in large scale pollution of soil, water, air and generally the damage of aesthetic environment.



Plate 2: Unmaintained open drainage used to throw the waste in major city road

About two-thirds of the wastes generated in the city are dumped in the city outskirts. In the absence of separate refuse collection system for different kinds of waste (commercial, institutional, hospital and industrial wastes) containing harmful materials, they are dumped with the domestic refuse in these open dumps. These mixed solid waste accumulations pose a wide range of environmental and health problems.

The dumping sites attract a large number of rag pickers who search for reclaimable materials. They scatter the wastes around making the site and the whole neighborhood blighted and unsightly. Hot ashes and combustible wastes are sometimes dumped at these sites, which cause fires and emit a lot of smoke. The decomposable wastes containing food

materials give rise to rodents and fly menace. Bits of waste paper litter the landscape. Some of the problems are: that wastes are dumped without segregation; some of the storage equipments used includes buckets, plastic bins and bags and metal bins with/without lids. Hotel and Restaurants are storing the wastes without any method or order and deposit the municipal bins. Vegetable and Fruit Markets have no containerized storage is not in practice. Meat and Fish Markets - standard storage equipments are not in use and the waste is deposited in the municipal bins at irregular intervals. Marriage Halls, Community Halls, etc - use municipal bins for depositing the waste. Hospitals and Nursing Homes - dispose off to the municipal bins and the Hassan Municipal Council is yet to implement rules regarding hospital wastes in these establishments. Construction and Demolition Wastes - the system is not in practice and use municipal bins for depositing the waste. Garden Wastes - the system is not in practice and use municipal bins for depositing the waste.

Apart from the public health aspect of solid waste disposal, there are aesthetic considerations. Aesthetic concerns are related to how humans react to wastes that are unsatisfactorily dumped. Uncollected refuse and insanitary dumps in full public view is an eyesore. The mental and social well being of people cannot be achieved merely by attainment of material

prosperity. It requires also a physical environment in which they can lead a comfortable and stress-free life.

The aesthetic degradation produced by the open dumps in Hassan is difficult to assess in any quantitative terms but it is nevertheless, very real. No accurate appraisal has been made of the impact of a dump on the value of neighboring property, but the value of real estate near badly kept dumps is greatly depreciated.

VI CATEGORIES OF WASTES

(a) Waste Generation

This study is mainly concentrated on household waste, commercial waste, institutional waste, small enterprises, demolition and remodelling debris. The detail sources of wastes are in the **Table 2**. The sharp increases in domestic solid wastes collected in recent years can be attributed not only to economic development and population growth but also to the changing modes of living and the expansion of the waste collection service facilities and the improvement of waste collection system. Even within the city, it varies from area to area, depending upon the social-economic conditions and the population density.

Table 2. Different sources of MSW generation in Hassan City

Sl. No.	Sources of Waste Generation	Waste Generation per day in MT	%
1	Households	40.05	65.63
2	Shops and Commercial Establishments	9.50	15.39
3	Vegetable and Fruit Markets	6.50	10.53
4	Meat/Fish/Slaughterhouse waste	0.95	1.54
5	Construction and Demolition waste	2.94	4.76
6	Medical waste	0.58	0.94
7	Floating population	0.74	1.20
	Total	61.71	100.00

Source: Hassan City Municipal Council, Hassan, 2014

(b) Waste Collection: The problem of collection of waste is very complex from the points of view of cost, health, sanitation, convenience and aesthetic. It is pertinent to point out that 80 percent of the entire cost goes to pay for collection and transportation. The Municipality has failed in removing piles of wastes found everywhere, mostly in residential areas. Indiscriminate littering of garbage in various parts of the city threatens the break out of epidemics and environmental hazards. The spilling of garbage on the roadside is common in the city (see **Plate 3**).



Plate 3: Uncleared street waste bin overflowing in the residential area

From the past two decades, the Hassan Urban Development Authority has virtually stopped forming new layouts. The issue now is of mushrooming 'revenue sites' all over the outskirts of Hassan. The so called 'revenue sites' are basically created out of huge tracts of agricultural land. Since these lands are transacted through real estate agents and not the designated government agencies, they have become another name for inadequate civic amenities. Here, the inadequate enforcement of town planning norms is evident. The worst thing about these plots is that their buyers do not even possess valid ownership titles.

The slums are generally found to be least desirable from the point of view of appropriateness of location for living. The authorities have been unable to clear the garbage from most of these slum areas in addition to open defecation problems (see plates 4, 5 & 6). These areas are not provided with regular garbage cleaning and proper sanitation facilities. Even access ways are ill planned and often absent. These dumpsites are attracting dogs, pigs and rodents.



Plate 4: Garbage scattered in one of the slums in Hassan



Plate 5: Uncleared wastes in the street in slum area



Plate 6: Slushy water flowing over the ground next to the public tap in slum area

The frequency of removal of waste varies from location to location within the city. More prosperous areas are better served, kept clean and swept on a regular basis. In some pockets of the city, the local body is experimenting with a bell system of door-to-door collection of domestic waste, reducing the number of public dust bins from about 800 numbers. Except for a very few areas there is no house-to-house collection service and because of budgetary constraints, inadequate equipment and planning, the solid waste in particular in low-income areas is not collected regularly/or at all.

An effort is being made for doorstep collection of waste through NGOs and private contractors and about only 5 percent of the population is covered under such a system in Hassan. Rest of the waste is therefore either collected from the street or from the dustbins.

(c) Waste Transportation

At present, the municipal solid wastes collected from different community dustbins are transported to disposal sites by the Municipal trucks and also private contract vehicles. There are 18 vehicles provided by the Municipal Body for transporting solid wastes to disposal site, out of which 7 trucks have a 4–5 tones capacity and 13 vehicles are small tractors which have 3 tone capacities. Every vehicle is supposed to make two trips per day, 10 km on an average. But in reality it is indicated that most of them make only one trip per day. Unfortunately no official data are available on the quantities of small scale industrial waste, building debris, hotels and commercial wastes. It is however not misplaced to conclude that a substantial portion of the daily generated solid waste is not cleared at all.

At present only about 52 percent of the total waste generated in the whole city is transported in three shifts to the land fill site spreads over 23 sq. km of land. The local body has inadequate vehicular fleet to transport the total waste generated within Hassan.

(d) Recyclable Waste

Hassan City is able to recover and recycle a large part of the solid wastes that it generates. It is estimated that around 10 percent of the waste is taken for recycling as recyclables, and the rest are discarded as it may not be remunerative to be picked up for recycling.

The City's recovery and trading network consists of nearly 500 waste pickers; 150 to 200 itinerant waste buyers of newspapers, plastics, glass, metal, clothes, and other materials; approximately 40 small and medium dealers and one wholesaler and also 15 reusable gunny bags dealers (see Plate 7, 8, 9, 10, 11, 12 & 13). There is one glass cleaning plant, 7 small plastic factories using waste materials. As a rough estimate, 1000 people at least earn their living by waste recovery and recycling in Hassan. The rag pickers remove about 4 tons per day for recycling. Municipal collectors and sweepers are estimated to take out 1 ton per day, in addition to the wastes removed by pickers.



Plate 9: Used news papers buying shops for recycling purposes



Plate 10: Waste buying shop



Plate 7: Selling milk socket to recycling waste buying shop



Plate 11: Reusable gunny bag



Plate 8: Waste buying shop for recycling materials



Plate 12: Manual segregation of recyclable waste



Plate 13: Loading recycling waste to factory for process

In Hassan, people employed for picking up plastics, glass, cardboard etc. from the waste are a common sight, leading to an appreciable decrease in their volume. And also significant reduction in quantities of waste generated can be effected if people are willing to change their habits and lifestyle, becoming friendly to the environment and developing a sense to conserve natural resources and to reduce economic burdens associated with management of solid wastes.

VII. LOCAL ADMINISTRATION

The municipal administration is generally responsible for providing 'basic amenities' as per the provisions made in various legislations governing local bodies in the States. The municipalities generally do not get enough financial resources or support from State or Central Government. They are supposed to generate their own financial resources. Due to inadequate tax efforts and collection and inefficient management, the municipal services are rather inadequately funded and are far from satisfactory. Growing costs, shortage of funds, inadequacies among the work force, etc., are making the situation worse with the passage of time. Both financially and physically, a city may be unable to provide facilities for waste collection, especially to the urban poor occupying fringe or other geographically inaccessible areas. The urban poor are left to contend with waste disposal on their own. The lack of support given to the urban poor in this area has serious consequences to their health and physical environment and generally to urban aesthetic ambience. Thus, the management of solid waste is an issue of vital importance to urban sustainability from the points of view of both universality and equity. The existing problems in the study area are:

Inadequate Resources - While allocating resources including finance, SWM has had a low priority resulting in inadequate provision of funds. The inadequacy of human resources is mainly due to the absence of suitably trained staff. There are no developed facilities for this training either.

Inadequate Technology - The equipment and machinery presently used in the system are usually outdated. This results in underutilization of existing resources and lowering of efficiency.

High Cost of Manpower - Out of the total expenditure, around 80 to 90 percent is accounted for manpower of which major portion is utilized for collection. Since citizens tend to throw waste on the adjoining road and outside the bin, the work of the collection staff is increased. Hence, the cost of collection increases considerably.

Societal and Management Apathy - The operational efficiency of MSWM depends on the active participation of both the municipal agency and the citizens. Since the social status of MSWM staff is low, there is a strong apathy towards them, which can be seen from the uncollected waste in many areas and the deterioration of aesthetic and environmental quality at the derelict disposal sites.

Low Efficiency of the System - The MSWM system is unplanned and is often operated in an utterly adhoc and primitive way. Neither the work norms are specified nor the work of collection staff appropriately measured, assessed, appreciated or supervised. The vehicles are poorly maintained and no schedule is observed for preventive maintenance. Further, there is little coordination of activities between different components of the system.

In this regard, Municipal Authorities will have to plan and execute the system in keeping with the increasing urban areas and population. There has to be a systematic effort in the improvement in various factors like institutional arrangement, financial provisions, appropriate technology, operations management, human resource development, public participation and awareness, and policy and legal framework for an integrated SWM system.

VIII. PLANNING AND AESTHETICS OF STRATEGIES

There is a daily backlog of about 28 tones of wastes getting accumulated in different parts of the city. The solid waste is not collected at all particularly in low-income areas such as urban village pockets, slum areas and revenue layouts in the outskirts of Hassan city. A well-prepared plan can have a positive impact on economic and social development while it takes sufficient care of the environmental up-gradation of slums. Preparation and implementation of MSWM plans for the slum areas can go a long way in solving the accumulated problems. For preparing such plans, the source of the problems has to be identified and solutions provided for short-term mitigation and long-term prevention. This has to be done through environmental management plans. A pocket of unattended and polluted areas destroy the image of a clean and planned city and creates urban form deterioration and health hazards. Encroachment on prime land creates obstacles to the intended development and use of that land. It creates low rise and high-density residential pockets. The basic fact is that ultimately the municipal administration is

responsible and accountable for maintaining an efficient waste disposal system in low income areas.

The cleaning of each street, lane, by lane, markets, etc, should be regularly supervised by the ward level supervisors. The prevailing laxity in attending to clogged up storm water drains and overflowing manholes should stop and being the nearest authority, ward level administration has to be proactively concerned with this problem. Such as:

- Stopping littering and indiscriminate dumping of refuse in open spaces, footpaths, lanes, streets, into drainage channels or lakes.
- Segregating waste at source into a pure biodegradable component and non-biodegradable waste.
- Provision of separate individual or communal bins for biodegradable waste in buildings, institutions, companies and residential colonies; these bins have to be emptied regularly and methodically.
- Increased awareness and knowledge on compost use and its numerous benefits for soil improvement is the key to increasing market demand and thus encouraging new composting initiatives. Since composting sites can be established at rural-urban boundary regions, villagers can buy and use these compost materials on their farms with comparatively less transport costs.
- Initiate awareness campaigns with regard to waste segregation, recycling and reuse. Certain construction materials must be separated for recycling, and separate recycling containers must be placed throughout the construction area so that proper separation of recyclables is possible. This construction debris may be used for imaginative topographic reclamation of land.

Adapting Legal Provisions - (Report of the Committee Constituted by The Hon. Supreme Court of India, 1999, p. 151) recommended to the Urban Local Administration.

A plan for a future MSWM system needs to be formulated as the population, land use and road and traffic conditions, financial conditions of the city, the life-style of the people, and the availability of labour and equipment will change as years pass by.

IX. CONCLUSIONS

In order to have a satisfactory, efficient and sustainable system of MSWM, proper planning, implementation, and management must be incorporated in the city.

Some of the suggestions are that arrangements for timely and regular clearance of garbage collected in the bins for disposal. Garbage should not be allowed

to burn on disposal sites. Encourage CBOs and NGOs in their role of assisting and facilitating proper waste management. It is strongly suggested that each ward in the city should form groups composed of citizens and local enterprises which work together to make the urban environment more beautiful or aesthetically appealing. Slums should be given special attention and provided full services to clear the waste. Stricter enforcement of air-quality standards has focused attention on burning dumps. In order to have a satisfactory, efficient, and a sustainable system of MSWM, proper planning, implementation, and management system must be incorporated in framing the national policy for SWM for the country. Spreading awareness amongst households and all waste generating establishments on the need for separation of waste at source and interacting with the Municipality to gradually reduce the number of street bins. Frequent or daily collection at doorstep may wholly eliminate these street bins.

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