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Identification and Investigation of Solid Waste Dump in Salem District

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ABSTRACT
Solid waste management is one of the most significant functions out by ULBs. However, the scarcity of suitable landfill sites is one of the constraints increasingly being faced by ULBs in the discharge of their functions. As a result, even several years after the issuance of the MSW Rules 2000, the state of MSW management systems in the country continues to raise serious public health concerns. Regional or inter-municipal solutions provide a viable option to redress this situation. Working together can be a practical and cost-effective way to discharge common tasks, share resources, and take advantage of the economies of scale that such arrangements would provide. This is applicable in the case of both large municipal bodies which experience scarcity of land resources, as well as smaller ones which may find technical and financial resources a challenge. Therefore, in public interest and with the aim of improving standards of public health and sanitation in the states, the Government of India has developed this Guidance Note on regional solid waste management to facilitate the creation of appropriate strategies by the states and ULBs. This note is the result of work done over a period of about 18 months, and aims to support decision making towards the implementation of regional arrangements for safe treatment and disposal of MSW. Regional approaches to MSW management are common in several countries, and have recently gained momentum in a few states in India. Studies undertaken attest to the importance of two factors in the successful implementation of regional initiatives: (a) an explicit policy, supporting the adoption of regional approaches; and (b) a robust institutional framework, underpinning development and implementation. In this respect, it is intended that this Guidance Note may form the basis for states to formulate and notify state-level policy directives to recognize regional initiatives, strategies to encourage their adoption, and tools to facilitate implementation. The Note also includes a few case studies illustrating frameworks and implementation strategies adopted in other jurisdictions and sectors. Frameworks observed include legislation supporting municipalities to priorities regional initiatives to effectively use available resources as well as options for Creation of regional solid waste management authorities or entities empowered by law to undertake waste management activities over a region or state; Creation of solid waste management 'regions'; and Municipalities jointly constituting a company, or common authority, to implement a regional waste management project. The present work aims at identifying, locating and quantifying the industrial and domestic waste dump sites located in and around Salem urban and rural districts of Salem, Tamilnadu state, India. In our project we identify the suitable location and investigation for dumping yard which is not affecting the environment.

KEYWORDS: Identification, Investigation, Solid Waste Dump, Salem District.

I INTRODUCTION

1.1 General

Generation of waste either in the form of solid waste or liquid waste is an inevitable component of the industrial and community activity. Nowadays, the waste generated is so complex in nature and consists of varied chemical or biological constituents. The waste generated is classified as hazardous waste and non-hazardous waste based on the chemical composition or reactive characteristics of the waste and/or detrimental potential towards man and environment. The waste disposed on open land by the community or industries forms an illegal or wild waste dump site. Illegal dumping of waste is every ones problem; it can be harmful to wildlife, plant sand water, and damage the surrounding community and state economy. Open dumping is a long-standing problem in this country and others, where certain locations become routine sites and dump piles attract additional dumping. It is a very common practice to dispose the waste generated by the community and the industries on to the land, into sea or into low lying area. The site say consist of fully or the partially industrial or domestic waste .The state of Tamilnadu is one of the fast developing states in India. Salem is among the major cities with high pace of development in all sectors of development like; education, instrumentation and information technology, Medical facility, industrialization and urbanization.

1.2 Introduction to solid waste management

Solid waste is the unwanted or useless solid materials generated from combined residential, industrial and commercial activities in a given area. It may be categorized according to its origin (domestic, industrial, commercial, construction or institutional); according to its contents (organic material, glass, metal, plastic paper etc); or according to hazard potential (toxic, non-toxin, flammable, radioactive, infectious etc).

Management of solid waste reduces or eliminates adverse impacts on the environment and human health and supports economic development and improved quality of life. A number of processes are involved in effectively managing waste for a municipality. These include monitoring, collection, transport, processing, recycling and disposal.

1.3 Waste reduction and reuse

Waste reduction and reuse of products are both methods of waste prevention. They eliminate the production of waste at the source of usual generation and reduce the demands for large scale treatment and disposal facilities. Methods of waste reduction include manufacturing products with less packaging, encouraging customers to bring their own reusable bags for packaging, encouraging the public to choose reusable products such as cloth napkins and reusable plastic and glass containers, backyard composting and sharing and donating any unwanted items rather than discarding them. All of the methods of waste prevention mentioned require public participation. In order to get the public onboard, training and educational programmers need to be undertaken to educate the public about their role in the process. Also the government may need to regulate the types and amount of packaging used by manufacturers and make the reuse of shopping bags mandatory.

1.4 Recycling:

Recycling refers to the removal of items from the waste stream to be used as raw materials in the manufacture of new products. Thus from this definition recycling occurs in three phases: first the waste is sorted and recyclables collected, the recyclables are used to create raw materials. These raw materials are then used in the production of new products. The sorting of recyclables may be done at the source (i.e. Within the household or office) for selective collection by the municipality or to be dropped off by the waste producer at a recycling centers. The pre-sorting at the source requires public participation which may not be forthcoming if there are no benefits to be derived. Also a system of selective collection by the government can be costly. It would require more frequent circulation of trucks within a neighborhood or the importation of more vehicles to facilitate the collection.

Figure 1.1 Recycling

Figure 1.1 Color coded recycling bins for waste separation at the source of production Another option is to mix the recyclables with the general waste stream for collection and then sorting and recovery of the recyclable materials can be performed by the municipality at a suitable site. The sorting by the municipality has the advantage of eliminating the dependence on the public and ensuring that the recycling does occur. The disadvantage however, is that the value of the recyclable materials is reduced since being mixed in and compacted with other garbage can have adverse effects on the quality of the recyclable material.

II SOLID WASTE MANAGEMENT HIERARCHIES

2.1. Waste Collection:

Waste from our homes is generally collected by our local authorities through regular waste collection, or by special collections for recycling. Within hot climates such as that of the Caribbean the waste should be collected at least twice a week to control fly breeding, and the harboring of other pests in the community. Other factors to consider when deciding on frequency of collection are the odours caused by decomposition and the accumulated quantities.

2.2 Treatment & Disposal

Waste treatment techniques seek to transform the waste into a form that is more manageable, reduce the volume or reduce the toxicity of the waste thus making the waste easier to dispose of. Treatment methods are selected based on the composition, quantity, and form of the waste material. Some waste treatment methods being used today include subjecting the waste to extremely high temperatures, dumping on land or land filling and use of biological processes to treat the waste. It should be noted that treatment and disposal options are chosen as a last resort to the previously mentioned management strategies reducing, reusing and recycling of waste (Figure 2.1).

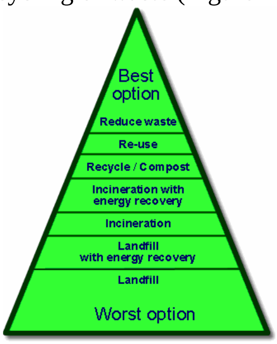

Figure 2.1 Solid waste management hierarchies

2.3 Thermal treatment
This refers to processes that involve the use of heat to treat waste. Listed below are descriptions of some commonly utilized thermal treatment processes.
1. Incineration
2. Pyrolysis and Gasification
3. Open burning:
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2.4. Dumps and Landfills
Sanitary landfills
Sanitary Landfills are designed to greatly reduce or eliminate the risks that waste disposal may pose to the public health and environmental quality. They are usually placed in areas where land features act as natural buffers between the landfill and the environment. For example the area may be comprised of clay soil which is fairly impermeable due to its tightly packed particles, or the area may be characterized by a low water table and an absence of surface water bodies thus preventing the threat of water contamination.

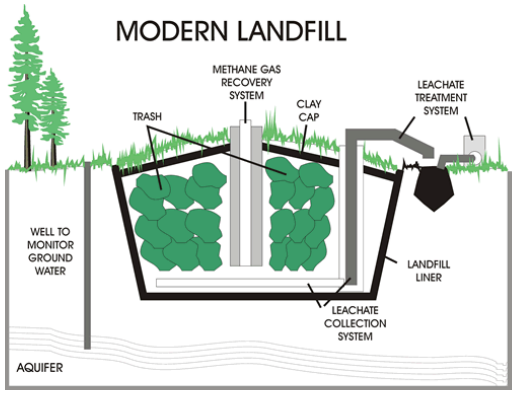

Figure2.2 Main features of a modern landfill

2.5 Controlled dumps:
Controlled dumps are disposal sites which comply with most of the requirements for a sanitary landfill but usually have one deficiency. They may have a planned capacity but no cell planning, there may be partial leach ate management, partial or no gas management, regular cover, compaction in some cases, basic record keeping and they are fenced or enclosed. These dumps have a reduced risk of environmental contamination, the initial costs are low and the operational costs are moderate. While there is controlled access and use, they are still accessible by scavengers and so there is some recovery of materials through this practice.

2.6 Bio-reactor Landfills:
Recent technological advances have lead to the introduction of the Bioreactor Landfill. The Bioreactor landfills use enhanced microbiological processes to accelerate the decomposition of waste. The main controlling factor is the constant addition of liquid to maintain optimum moisture for microbial digestion. This liquid is usually added by re-circulating the landfill leach ate. In cases where leach ate in not enough, water or other liquid waste such as sewage sludge can be used. The landfill may use either anaerobic or aerobic microbial digestion or it may be designed to combine the two. These enhanced microbial processes have the advantage of rapidly reducing the volume of the waste creating more space for additional waste, they also maximize the production and capture of methane for energy recovery systems and they reduce the costs associated with leach ate management. For Bioreactor landfills to be successful the waste should be comprised predominantly.

2.7 Biological waste treatment:
Composting is the controlled aerobic decomposition of organic matter by the action of micro organisms and small invertebrates. There are a number of composting techniques being used today. These include: in vessel composting, windrow composting, vermin composting and static pile composting. The

process is controlled by making the environmental conditions optimum for the waste decomposers to thrive. The rate of compost formation is controlled by the composition and constituents of the materials i.e. their Carbon/Nitrogen (C/N) ratio, the temperature, the moisture content and the amount of air.

2.8 Anaerobic Digestion:
Anaerobic digestion like composting uses biological processes to decompose organic waste. However, where composting can use a variety of microbes and must have air, anaerobic digestion uses bacteria and an oxygen free environment to decompose the waste. Aerobic respiration, typical of composting, results in the formation of Carbon dioxide and water. While the anaerobic respiration results in the formation of Carbon Dioxide and methane. In addition to generating the humus which is used as a soil enhancer, Anaerobic Digestion is also used as a method of producing biogas which can be used to generate electricity.

III INTEGRATED SOLID WASTE MANAGEMENT

Integrated Solid Waste Management (ISWM) takes an overall approach to creating sustainable systems that are economically affordable, socially acceptable and environmentally effective. An integrated solid waste management system involves the use of a range of different treatment methods, and key to the functioning of such a system is the collection and sorting of the waste. It is important to note that no one single treatment method can manage all the waste materials in an environmentally effective way. Thus all of the available treatment and disposal options must be evaluated equally and the best combination of the available options suited to the particular community chosen. Effective management schemes therefore need to operate in ways which best meet current social, economic, and environmental conditions of the municipality.

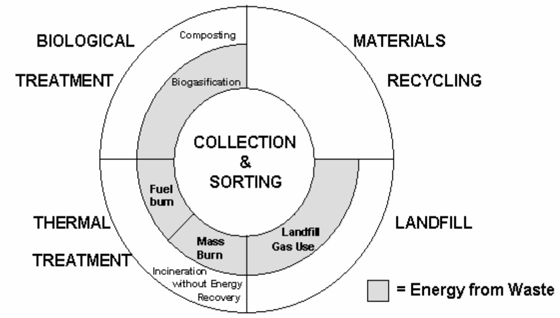

Figure 3.1 Integrated Solid Waste Management

3.1 Solid Waste Generation:

An indication of how and where solid wastes are generated is depicted in a simplified form in Fig. Both technological processes and consumptive processes result in the formation of solid wastes. Solid waste is generated, in the beginning, with the recovery of raw materials and thereafter at every step in the technological process as the raw material is converted to a product for consumption. Fig Shows generation of solid waste during technological processes involving mining, manufacturing and packaging. The process of consumption of products results in the formation of solid waste in urban areas as shown in Figure.3.1. In addition, other processes such as street cleaning, park cleaning, waste-water treatment, air pollution control measures etc. also produce solid waste in urban areas. A society receives energy and raw material as inputs from the environment and gives solid waste as output to the environment as shown in Fig. In the long-term perspective, such an input-output imbalance degrades the environment.

3.2 Environmental Impact of Solid Waste Disposal on Land:
When solid waste is disposed off on land in open dumps or in improperly designed landfills (e.g. in low lying areas), it causes the following impact on the environment.

(a) Ground water contamination by the leach ate generated by the waste dump
(b) Surface water contamination by the run-off from the waste dump
(c) Bad odor, pests, rodents and wind-blown litter in and around the waste dump
(d) Generation of inflammable gas (e.g. methane) within the waste dump
(e) Bird menace above the waste dump which affects flight of aircraft
(f) Fires within the waste dump
(g) Erosion and stability problems relating to slopes of the waste dump
(h) Epidemics through stray animals
(i) Acidity to surrounding soil and
(j) Release of green house gas

3.3 Objective of Solid Waste Management
The objective of solid waste management is to reduce the quantity of solid waste disposed off on land by recovery of materials and energy from solid waste as depicted in Fig. This in turn results in lesser requirement of raw material and energy as inputs for technological processes. A simplified flow chart showing how waste reduction can be achieved for household waste is shown in Fig. Such techniques and management programs have to be applied to each and every solid waste generating activity in a society to achieve overall minimization of solid waste.

3.4 principles of municipal solid waste management:

Municipal Solid Waste Management involves the application of principle of Integrated Solid Waste Management (ISWM) to municipal waste. ISWM is the application of suitable techniques, technologies and management programs covering all types of solid wastes from all sources to achieve the twin objectives of (a) waste reduction and (b) effective management of waste still produced after waste reduction.

3.5 Waste Reduction:

It is now well recognized that sustainable development can only be achieved if society in general, and industry in particular, produces 'more with less' i.e. more goods and services with less use of the world's resources (raw materials and energy) and less pollution and waste. Production as well as product changes have been introduced in many countries, using internal recycling of materials or on-site energy recovery, as part of solid waste minimization schemes.

3.6 Effective Management of Solid Waste

Effective solid management systems are needed to ensure better human health and safety. They must be safe for workers and safeguard public health by preventing the spread of disease. In addition to these prerequisites, an effective system of solid waste management must be both environmentally and economically sustainable. Environmentally sustainable: It must reduce, as much as possible, the environmental impacts of waste management. Economically sustainable: It must operate at a cost acceptable to community. Clearly it is difficult to minimize the two variables, cost and environmental impact, simultaneously. There will always be a trade off. The balance that needs to be struck is to reduce the overall environmental impacts of the waste management system as far as possible, within an acceptable level of cost.

An economically and environmentally sustainable solid waste management system is effective if it follows an integrated approach i.e. it deals with all types of solid waste materials and all sources of solid waste (Fig. 2.6). A multi-material, multi-source management approach is usually effective in environmental and economic terms than a material specific and source specific approach. Specific wastes should be dealt with in such a system but in separate streams an effective waste management system includes one or more of the following options:

(a) Waste collection and transportation.

(b) Resource recovery through sorting and recycling i.e. recovery of materials (Such as paper, glass, metals) etc. through separation.

(c) Resource recovery through waste processing i.e. recovery of materials (such as compost) or recovery of energy through biological, thermal or other processes.

(d) Waste transformation (without recovery of resources) i.e. Reduction of volume, toxicity or other physical/chemical properties of waste to make it suitable for final disposal.

(e) Disposal on land i.e. environmentally safe and sustainable disposal in landfills.

3.7 Functional Elements of Municipal Solid Waste Management

The activities associated with the management of municipal solid wastes from the point of generation to final disposal can be grouped into the six functional elements:

(a) Waste generation;

(b) Waste handling and sorting, storage, and processing at the source;

(c) Collection;

(d) Sorting, processing and transformation;

(e) Transfer and transport; and

(f) Disposal. The inter-relationship between the elements is identified.

IV HIERARCHY OF WASTE MANAGEMENT OPTIONS

Current thinking on the best methods to deal with waste is centered on a broadly accepted 'hierarchy of waste management' (arrangement in order of rank) which gives a priority listing of the waste management options available (see Fig). The hierarchy gives important general guidelines on the relative desirability of the different management options. The hierarchy usually adopted is

(a) Waste minimization/reduction at source,

(b) Recycling,

(c) Waste processing (with recovery of resources i.e. materials (products) and energy),

(d) Waste transformation (without recovery of resources) and

(e) Disposal on land (land filling).

IV LINKAGES BETWEEN MUNICIPAL SOLID WASTE MANAGEMENT SYSTEM AND OTHER TYPES OF WASTES GENERATED IN AN URBAN CENTRE

Other than municipal solid waste, the following types of waste may also be generated in urban centers:

(a) Industrial Waste –hazardous and non-hazardous waste from industrial areas within municipal limits.

(b) Biomedical Waste – waste from hospitals, slaughter houses etc.

(c) Thermal Power Plant Waste – Fly ash from coal-based electricity generating plant within municipal limits.

(d) Effluent Treatment Plant Waste – Sludge from sewage treatment plants and industrial effluent treatment plants.
(e) Other Wastes

Special wastes from non-conforming areas or special units.
All waste streams must be managed by their own waste management system as shown in Fig. 2.12. However, the following aspects of inter-linkages between different waste streams are considered important.
(a) Different waste streams should not be managed in isolation. Inter-linkages between various streams should be encouraged if these lead to more efficient and economical recovery of the two important resources from solid waste – material and energy. For example, in some countries solid biodegradable waste and sewage are mixed to improve biological processing of solid waste.
(b) Different types of solid waste eventually reach any one of the following three types of landfills – MSW landfills, hazardous waste landfill or monofills for designated waste. Some important observations are:
(i) All hazardous waste – whether from MSW stream, industrial waste stream or any other waste stream – should be disposed off in "Hazardous Waste Landfills".
(ii) Large quantity non-hazardous waste (e.g. Construction and demolition waste or flyash) should be disposed off in monofills (i.e. "Construction Waste Landfills" or "Ash Disposal Sites").
(iii) Municipal solid waste after waste processing as well as non- hazardous, small quantity waste (typically less than 15% of the MSW quantity) from non-municipal sources can also be disposed off in MSW landfills, if the compatibility of such wastes with municipal waste is ascertained. Non-hazardous sludge (small quantity) can also be accommodated in a MSW landfill provided it has been dewatered and dried prior to disposal.
(c) At present, the solid waste management practices are to comply with the following sets of regulations:
(i) Section dealing with conservancy and sanitation in the Municipal Acts of each state.
(ii) Hazardous Waste Management and Handling Rules (1989), The Ministry of Environment & Forests (MoEF).
(iii) Biomedical Waste Management and Handling Rules (1998), MoEF.
(iv) Municipal Solid Waste Management and Handling Rules (Draft) (1998), MoEF.
(v) Special notifications for other wastes from time to time, MoEF.
The inter-linkages between different waste streams are not clearly identified in these rules and regulations. The municipal solid waste managing authority should ensure that small-quantity waste from other streams is accepted for land filling only after certification that the waste is non-hazardous by a regulatory authority (e.g. State Pollution Control Board).

V STUDY AREA

Salem pronunciation (help info) is a city and a Municipal Corporation in Salem district in the Indian state of Tamil Nadu. Salem, which is also called Mango city, is located about 160 kilometres (99 mi) northwest of Coimbatore and about 340 kilometers (211 mi) southwest of the state capital, Chennai in the North Central part of the state. Salem is the fifth largest city in Tamil Nadu in terms of population after Chennai, Coimbatore, Madurai, and Tiruchirappalli respectively. The area of the city is 100 km2 (39 sq mi). It is the fifth Municipal Corporation and Urban agglomeration commissioned in Tamil Nadu after Chennai (year 1919), Coimbatore (1981), Madurai (1971) and Tiruchirappalli (1994) respectively. Salem Corporation consists of 60 wards categorized under 4 Zonal Offices, namely Suramangalam Zonal, Hasthampatty Zonal, Ammapet Zonal, and Kondalampatty Zonal.Salem is a part of Western Tamil Nadu and is located at the base of the popular tourist destination of the Yercaud hills.
Early history According to an Indian legend, Sukavana Isvarar Puranam, the city, Cheralam, was founded by Cherarnan Peruman, a leader of the Chera Dynasty, because he wanted to bathe in the river Thirumanimuthu Aru and worship the god Isvarar there.[2] Cheralam translates to "mountain range". cheralam , Shalya, Sayilam and Sailam are found in inscriptions referring to the country around the hills. Salem and the hilly region around it were part of the Chera and The city was ruled by Kings who were known as the Kurunila Mannargal of ancient Tamil Nadu. Inscriptions from the Ganga dynasty have been recovered from parts of the district.

5.1 Geography and climate:

Waste material at a glance in salem district Around 350 MT solid wastes were collected from four zones in the city and dumped at yards in Erumapalayam, Suramangalam, Veeranam and Maniyanur.In the past 50 years since the dumping began, around 2 lakh MT of solid waste were dumped at Erumapalayam, according to sources here.As many as 52 corporation tractors collect solid waste from 39 wards; 30 vehicles of a private contractor collect solid waste from 21 wards and dump it at the 26-acre dump yard.

The Erumapalayam yard is already overflowing, yet dumping of waste continues. A corporation official said that though Solid Waste Management (SWM) plant at Chettichavadi village, on the city outskirts, is functioning, due to non-availability of adequate transport vehicles, 120 tonnes of wastes are still dumped at Erumapalayam.

Fig no: 5.1 Geography and climate

He added that tractors available with corporation transport 150 tons of waste to the plant at Chettichavadi. Residents had already protested against the dumping of garbage in the area and said that the dumping had polluted the groundwater. They wanted the entire operations to be moved to Chettichavadi. A corporation health official admitted that environmental pollution is a problem because of burning of garbage and had instructed sanitary inspectors to take strict action against persons involved in burning of tyres and other chemical substances. In 50 years, around 2 lakh metric tons of solid waste have been dumped at Erumapalayam

5.2 Background and need for the guidance:

The responsibility for solid waste management lies with the respective Urban Local Bodies (ULBs), consisting of municipal corporations, municipalities, nagar panchayats, etc., (collectively referred to as the 'Authorities'). The Municipal Solid Waste (Management and Handling) Rules,2000 (the 'MSW Rules'), issued by the Ministry of Environment and Forests, Government of India, under the Environment (Protection) Act, 1986, prescribe the manner in which the Authorities have to undertake collection, segregation, storage, transportation, processing and disposal of the municipal solid waste (the 'MSW') generated within their jurisdiction under their respective governing legislation.

5.3 Implementation through Private Participation:

The Government of India recognizes the magnitude, scope and nature of: (i) investment; (ii) technical expertise; and (iii) resources required for a viable Regional MSW Project. Most Authorities face shortages of technical and managerial staff and systems. A regional project will enable the Authorities to discharge their statutory municipal waste management functions in a scientific and viable manner in accordance with applicable laws. A regional project can be implemented either through:
(a) a government body/utility that may be specifically incorporated for implementing such regional projects in the state (which may thereafter implement through its own staff, or contract out activities); or (b) through a Public Private Partnership (PPP) structure, wherein a concession is granted by the land-owning entity (state or lead ULB). A robust PPP framework will be based on the following principles: Provide for a framework that permits private investment and debt financing of Regional MSW Projects; Provide a legal framework for the enforcement of contractual obligations between municipalities, on the one hand, and municipalities and private entities, on the other; Provide a framework for grant of contracts that is clear, transparent and stable to encourage Transfer station, Rajkot city, Gujarat, India. Small vehicles climb a ramp to empty waste into larger vehicles stationed at a lower level. Transfer stations enable costs of transportation over longer distances to be optimized. Greater private participation and fair sharing of risks between private participants and municipalities; and Permit creation of special funds/escrow accounts to enable securing of payment obligations of municipalities to the private developers. Furthermore, it is proposed to harmonies the existing institutional structures and evolving legislations to create a robust and transparent framework for the implementation of Regional MSW Projects in the country.(Figure 5.2)

Figure 5.2 Implementation through Private Participation

5.4 Methodology:

Waste disposed sites must be assessed to determine the extent of contamination before cleanup is initiated. Site assessment follows a common procedure that is divided into three phases. Site assessment is initiated whenever the existence of hazardous waste site is suspected, which may include a leak in the underground storage tank, the discovery of hazardous chemicals in drinking water supply, a high incidence of localized illness, or a routine property transfer. Preliminary assessment, remedial investigations and feasibility study follow the format of the general site assessment phases (Richard, 1997). The three site assessment phases are Phases-I, -II and -III; each builds upon the previous phase with more extensive information. A Phase-I assessment called as initial assessment study or preliminary assessment study focuses on ‘‘soft’’ or non-sciatic information and is analogous to a background search. Phase-I studies involve paper research including a chemical inventory evaluation, interviews with current and former personnel and neighbors, and regulatory agency record searches and interviews. Title searches and reviews of historical ownership are also necessary under liability clauses. Other records that are often reviewed include aerial photographs, national agency permits and violations, zoning maps, tax records, fire records, and newspaper articles. The on-site inspection and personnel interviews provide information and perspectives that cannot be obtained through records and searches. Often retirees neighbors, and employees of 20+ years are able to relay information on the past disposal practices and the location of the buried wastes. A walk-through of the site can often provide clues of improper waste disposal. Signs such as stained soil, an unlined pit, or concrete pads associated with an abandoned fuel farm, solvent storage area, pesticide mixing/loading zone, or gasoline station may provide the evidence necessary to initiate Phase-II study. Phase-I reports do not certify that the site is free of contamination, but they provide a basis for further study or investigation. If the suspicions that were first raised to initiate the site assessment are confirmed in the Phase-I evaluation, a Phase-II study is warranted to confirm or deny the pres- ence of the hazardous wastes at the site. A Phase-II study includes finalising any record searches that were not com- pelted in the Phase-I assessment. A detailed evaluation of pathways and potential receptors has begun, which may include an analysis of the subsurface by a hydrologist to assess ground water flow directions and travel times to drinking water wells or other receptors. If ecological damage is evident, a biologist may assess critical habitat or the need for ecological risk assessment. Phase-II assessments often involve increased sampling efforts. Based on where the contamination is expected, surface soil ‘‘grab samples’’ (random samples collected without any guidance from prior knowledge), soil cores, surface water samples, and water samples are collected after the installation of the monitoring wells. There are no firm rules on the degree to which sampling are conducted during a Phase-II assessment; sampling intensity evolves on an ad hoc basis through negotiations among the site owners, their consultants, and state regulators. If the Phase-II studies show that the site is contaminated, a Phase-III study is initiated. The purpose of a Phase-III investigation is to detail the extent of contamination in terms of the area, volume and contaminant concentrations. Depending on the source characteristics, age of the site, and predominant pathways, the source and adjacent areas (soils, subsur- face, and/or ground water) may be sampled extensively. With appropriate sampling designs, contaminant con- contractions data over depth and area provide sufficient information to assess the site hazard (i.e., the need for site cleanup) and provide criteria for the design of reme- dial process (Richard, 1997).

Based on the experience gained from field visits, phys- ical observation of the waste disposed, quantity and nat- ure of the waste disposed, each site was given with grading based on polluting potential of the site. For selected sites, water samples were collected from nearby surface or bore wells and analysed for possible contamination.From the study, it was observed that not much importance is given for segregation, handling and dis- posal of waste both by the general community and industrial units. There is no specific scientific methodology suggested or adopted for collection and disposal of household waste generated by a family or from the industrial units. By understanding the importance of the waste management on community health and economics of the state, the state government made attempts to develop engineered land fill facility for sciatic treatment and disposal of domestic waste generated by the civil community and industrial hazardous waste generated by all sectors of industries in the state. The main objective of this study is to deal with the following issues: to list all dump sites and quantify impact assessment of each site, risk assessment and proposals for the remediation activities. The scope of the present work is to mainly deal with identifying, locating, quantifying and documentation of all illegal or open waste dump sites of both municipal and industrial waste existing in and around Salem urban and rural districts. This paper provides a clear picture of the location of waste sites, waste spread area and highlights the estimated quantity of both domestic and industrial waste disposed. The present study aims at documentation of waste disposal sites in and around Salem districts.

5.5 Background:

The state government along with Tamilnadu State Pollution Control Board is in the process of developing treatment storage and disposal facility for scientific handling and disposal of waste generated by the general community and industries. The facility in- cludes design and development of engineered land fill facilities to dispose domestic waste and industrial hazardous waste in land fills for the entire state. For effective design and efficient management of the facility, clear data base on the waste quality, quantity, generation rate from community and industries. The state is planning to have documentation of all waste disposal sites that are present across the state and the details of quantity, quality waste disposed and location of the disposal site with access to the site. Age of the site, soil condition, land use pattern, ground water details and its quality information are very much essential for optimal design of the treat- ment disposal facility. The gathering of details of sites plays a vital role in the estimation of total cost of the project as it involves cost for segregation of hazardous and non-hazardous waste and transportation to respective treatment disposal facility, and also incurs cost of remediation activities to be planned, executed for illegal/open waste disposal sites. Hence, it is important to identify all sites existing across the state and characterize the waste to the extent possible.

5.6 Study area:

Salem is located at 11.669437°N 78.140865°E. The average elevation is 278 m (912 ft). (Figure5.3) The city of Salem is surrounded by hills on all sides viz. Nagaramalai to the north, Jarugumalai to the south, Kanjamalai to the west, Godumalai to the east and the Shivery Hills to the north east. The Kariyaperumal Hill is situated within the city to the southwest. Salem city has 4 constituencies viz. Salem North, Salem South, Salem West and Veerapandi.[7] An MP constituency also had been created in the name of Salem containing Salem city, Omalur, Edappadi taluks of Salem district. Salem city is administrated by Salem City Municipal Corporation, which consists of 60 Wards. It also serves as the headquarters of the district with the same name (Salem District).

Figure5.3 Study area

5.7 Historical Population In Salem:

As per the 2011 census results, Salem UA has a population of 919,150. City Population grew from 696,760 in 2001 to 831,038 in 2011. As of the 2001 Indian Census the Salem Urban Agglomeration had a total population of 751,438, encompassing the town of Salem (696,760), Kondalampatti (16,808), Kannankurichi (14,994), Neykkarappatti (9,869), Mallamooppampatti (6,783) and Dalavaipatti (6,224). The population in 1991 was 499,024.

Road:

Salem city is on NH7 (which connects the two major cities Coimbatore and Salem), NH47 from Coimbatore to Salem making it a transit hub. The North-south corridor (express highway project in India) makes the city easy to reach from Salem and Coimbatore (on average, 2.1 hours from Coimbatore and 3 hours from Salem).

2. Rail:

Salem Junction Railway station is located in the suburb of Suramangalam, 5 km to the west of Salem. Salem is a divisional headquarters in the Southern Railway which was carved out of the existing Palakkad and Tiruchchirappalli divisions in the year 2007. Salem Junction is a very important railway station in the Southern Railway. Salem is connected by rail to all important cities and towns in the rest of the country. The station is well connected by buses to other parts of the city around the clock.

3. Air:

Salem Airport (IATA: SXV, ICAO: VOSM) is located on Salem-Salem Highway (NH-7) in a place called Kaamalapuram near Omalur, which is about 20 km from the city. Though the Airports Authority of India (AAI) had spruced up the airport and made it ready for operation in 1993, airlines did not show interest to fly fearing low patronage. Kingfisher Airlines did provide a service from Chennai, Initially it was daily service but due to low patronage it was reduced to five days a week, but terminated the service in 2012 owing to its financial problems. In recent times however, SpiceJet has shown some interest in starting flights to Salem. But Till now no signs of date of service. The nearest major airports are Tiruchchirappalli TRZ (135 km), Coimbatore CJB (152 km), Bengaluru BLR (202 km) and Chennai MAA (338 km).

VI METHODOLOGY

The identification, quantification and assessment for all waste dump sites were undertaken as follows. Identification of sites Information related to all waste disposal sites were collected from all possible sources like; government agencies, pollution control board offices, regional offices, newspaper cutting, local news channels, information from the local people, etc. The collected topography maps related to area located the dump site and marked a radius of 500 m around the site on the map. The on- site inspection and personnel interviews provided vital information on waste type and age of the dump site, with possible source of waste.

6.1. Description of the site:

After identifying the dump site, if the site was found to possess industrial waste, then each site details, such as waste quantity, quality, age of dump site, waste spread area, nearby water bodies (both surface and ground water), important building or monuments and historical places were recorded. Socio economic data were also collected for the respective site.

6.2 Quantification of the waste:

Waste quantity was calculated by physically measuring the waste spread area and the depth of waste disposed. By knowing the volume of waste and approximate density, the quantity of the waste was evolved. In case of mixture of industrial and domestic waste, waste quantity was calculated according to their individual volume of waste as approximated or calculated.

6.3 Assessment of the site:

Grab samples of waste were collected and analyzed for their possible chemical composition; this was done only for selected sites because of the resource constraint and time limitations. Soil samples from the waste dump site (just below the waste pile), surface and ground water samples from water bodies located within 500 m from the location of the dump site were collected and tested at the laboratory. Standard procedures were followed in collecting and testing of the wastes and water samples from waste dump sites.

6.4. Sampling procedure:

By selecting the existing surface or ground water sources/wells around the site located within 500 m ra- dius around the dump site. Minimum of four water samples around the dump site in four directions was collected. Grab samples were taken for solid waste samples disposed on land.

6.5 Testing parameters:

Soil and water samples collected were tested for their possible contamination. Soil samples were analyzed for possible metal ion concentrations or the major pollutants which can be anticipated based on the industrial activity in the surrounding area. The water samples collected were analyzed for various parameters with drinking water standards as the reference.

6.6 Plans for rehabilitation works:

After detailed analysis of the site condition and the type of waste disposed. The sites will be prioritized and ranked based on severity of the problem, in case the sites require septic remedial measures, the same will be addressed as the case may be in Phase-II operations. Based on the intensity of pollution and importance of the site, detailed rehabilitation works as required in each case will be proposed. Septic action plans and recommendations for rehabilitation will be suggested. This part of the work will be addressed after successful com-Platoon of the first phase of inventory and detailed stud- ies of the dump sites.

6.7 Waste generation:

Waste composition:

Tables 6.1 and 6.2 shows the municipal waste generation and physical composition of waste generated by civil community of Salem. It can be observed from Table.6.1 that the waste generated by the residents is about 54% and is the highest among other sources. Whereas the waste generated from hospitals, hotels and restaurants is about 20%, and markets contribute about 14% of the total waste generated by community. Table.6.2 shows the waste composition; it is clear that the waste consists of 72% participle waste, 11% paper, 6% plastic, 1.4% glass and about 1% hazardous waste. The hazardous waste in municipal waste may consist of household hazardous waste like; light tube, batteries, pesticides, medicine/drugs and similar such items.

Table 6.. . 1 :Municipal waste generation rate in Salem

Source	Quantity (t/day)	Composition (% byweight)
Residential	780	54
Markets	210	14
Hotelsandrestaurants	290	20
Commercial premises	85	6
Slums	20	1
Hospitals	25	2
Street sweepings, parks, openplaces	40	3

Table 6.2 Physical composition of municipal waste in Salem

Physical composition of municipal waste in Salem

Waste type	Composition (% by weight)						
	Resident al	Com cial	Hotels staurants	Market s	Slums	Street sw eepings	All sources
Putrescible	71.5	15.6	76.0	90	29.9	90	72.0
Paper	8.4	54.6	17.0	3	2.5	2	11.6
Plastics	6.9	16.6	2.0	7	1.7	3	6.2
Glass	2.3	0.7	0.2	–	8.4	–	1.4
Metals	0.3	0.4	0.3	–	0.2	–	0.2
Dustandash	8.1	8.2	4.0	–	56.7	5	6.5
Clothes, rags and	1.3	4.0	0.4		0.5	–	1.0
Hazardous	1.2	–		–	–	–	0.9

6.8 Municipal solid waste:

A recent survey of municipal solid waste revealed that approximately 1450 tons of municipal solid waste, excluding industrial waste and construction demolition waste, is produced each day in the city of saelm. This equates to an average waste generation rate per capita of 0.27 kg/day. The major constituents of municipal solid waste in Salem are organic matter/putrescible waste. Typically, this comprises 74% of the municipal waste stream. The proportion of organ- ic matter/putrescible waste is source-dependent ranging from approximately 16% of waste from commercial premises to 90% for market waste and street sweeping waste.

Biomedical waste

Approximately 25 tons of waste is generated per day by healthcare institutions in salem The composition of biomedical waste in Salem, kitchen and office wastes and other uninfected and non-hazardous wastes comprises a significant propor- tion of waste generated by healthcare institutions (about 40–70% by weight); Infected and potentially infected waste (including body parts and tissue) also constitutes a significant proportion of the biomedical waste (about 22–60% by weight). While recyclables constitute a rela- tively major component of waste from healthcare insti- tutions (about 15–25% by weight), much of it is infected or potentially infected and must be handled and treated separately and accordingly. Hazardous chemicals and drugs form only a minor proportion of biomedical waste.

6.9 Hazardous Industrial Waste:

Data reveal that more than 1000 industries in the state are registered as industries generating hazardous waste these industries generate almost 80,000 tons of hazardous waste per year. The hazardous waste is presently temporarily stored or stockpiled with- in industrial premises. The emissions from un scientific disposal of solid/liquid hazardous waste from industries contain most dangerous heavy metals, acids, oil emulsions, toxic wastes or infectious waste which can spread dreaded diseases to man or damage the environment. Fig. 1 shows information on distribution of small, medium and large scale industries in the state.

6.10 Present Practice:

As on today, the state does not have any scientific treatment and disposal facility to treat and dispose the waste generated by its civil community or the industries. Both domestic waste and industrial waste are being disposed on open land, or low lying area or into the sea. The waste disposed leads to generation of leach ate which contaminates the subsoil, surface and ground water resources.

VII RESULTS AND DISCUSSION

During the study period, in study area, a visit was made to all the waste disposal sites and a survey con- ducted for type of the waste being disposed at all sites; photographs were taken for all sites. The dump site de- tails, such as location of the site, waste spread area, type of waste (domestic/industrial), nature of waste (solid/ semi solid/liquid waste), nearby industrial area, numbers of years of disposal and quantity of waste being dumped, were collected from the local people/villagers. The waste spread area was measured or approximated as the case may be. The volume of the waste was calculated/approximated as the case permits and thereby the quantity of the waste was assessed. The hazardous waste generation in the state is about 40,000 tons per year. Municipal waste generated in Salem city alone is about 0.2 million tons per year. There is accumulated quantity of about 5000–6000 tons of rejects from KCDC, which consists of glass, rubber, and ferrous material waste. This waste may be considered as industrial waste and disposed at Treatment Storage and Disposal Facility (TSDF). From the study, it was found that sites which need immediate attention and come under severe impact category are 27 numbers and that of medium and low impact are 18 and 6 numbers, respectively. From the field data collected, the industrial waste disposed at sites as on date will be about 25,000 tons and that of domestic waste is about 60,000 tons. With present rate of generation, the industrial waste present on sites will be of one year and that of domestic waste is of two months. The details of dump sites and location Waste dump sites around Salem–Chennai road.

Table no: 7.1 Waste dump sites around Salem–Chennai road

Site no.	Typeof waste	Waste spread area (acres)	IW (tons)	MW (tons)	Risk factor	Remarks
11	Industrial and domestic wastes including waste oil	3	150	700	S	It was found that the oil waste spread over 25 m^2 and domestic waste was burning openly
12	Industrial/domestic waste	3	75	100	S	Stone polishing powder anddomestic waste
13	Industrial/domestic waste	3	650	850	S	Since 6 years the waste being dumped at thisplace
14	Domestic waste	1.5	0	200	M	Domestic waste was burning
15	Domestic waste	1.5	0	200	M	Domestic waste was spread over agricultural land andit was burning
16	Domestic waste	0.5	0	100	L	Villagers are against disposing of waste in lands
17	Industrial waste	0.2	25	0	S	Wastes includes oil, glass wool
18	Packaging waste	0.2	0	75	L	Stored in private land withcompound walls
19	Domestic waste	2	0	250	L	Used as land filling material

Note: IW, industrial waste; MW, municipal waste.

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