



## **Solid Waste Management: A Case Study of Arppukara Grama Panchayat Of Kottayam District, Kerala (India)**

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The rising pressure of Population, together with the constantly changing technologies, and development perspectives, contribute to the ever increasing volumes of wastes in different forms. The solid and liquid wastes generated in the urban areas were considered a burden to the society, and hazardous to the environment. The fact is that the growth of consumerist culture and aimless throwing of refuse by the people created the outbreak of environmental pollution. Unhygienic environment and solid waste accumulation coincided with mosquito breeding which causes, the spread of most epidemics. The rationale behind most of the diseases is the unhygienic pattern followed by the people both in rural and urban areas. As an environmental package, the disposal of solid waste from different sources, such as house holds markets, commercial areas, slaughter houses, hospitals and industries, therefore assumed crucial importance. So as a part of the theory and practice, a study on the area, solid waste management of Arppukara Grama Panchayat of Kottayam district is taken into consideration. The study conducted here proposes, to examine the *quality and* quantity of the solid waste generated in the panchayat and also it's impact on the existing social, economical, environmental and ecological systems.

Now Solid Waste Management is an important area of study with local bodies, viz, Panchayat, Municipality and Corporations. As apart of the obligations, street sweepings, market sweepings, and household waste collection etc. were undertaken

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by the local bodies as much they could. However, the solid waste collection, and management in urban and rural areas are not satisfactory in its full sense. The major difficulties faced by the local bodies are non availability of suitable land, dumping yard, inadequate infrastructure, resistance from public against dumping etc. The unacceptability of open dumping and thereby land filling is due to unhygienic reasons. The local bodies took it in the easy sense, the disposal of solid and liquid wastes.

In recent years, the flow of solid wastes in all over the world has been increasing. There is no question, that, this trend poses ever-increasing problems for society. Already, many cities are having trouble in disposing of mounting heaps of trash. Neighboring areas are reluctant to serve as the cities dumps and locations, that are suitable for land fill operations are getting scarce. Other methods of waste disposal are now recognized to create problems of their own. Burning garbage pollutes the air, while treatment of liquid wastes leaves sludge, which must be disposed of. Moreover, dumping wastes into the ocean and other water bodies is not costless to society; sludge dumped in to the sea can kill or contaminate marine life and pollute nearby waters and beaches. The changing composition of solid wastes also adds to the problem of disposal. For example, plastics, (which are non-degradable and often have harmful combustion properties) make up an increasing percentage of solid wastes. All in all the problem of solid waste disposal can hardly be viewed with equanimity, ie, it surely represents a major environmental problems, that is likely to grow worse`.

Economic growth leads to urbanization and urbanization leads to environmental waste pollution. The proper and efficient way of handling the waste materials requires a good deal of total sanitation and public awareness programmes. Public should be aware of the necessity of hygienic disposal of wastes generated. It is really a matter of great concern for the present however, because, waste generation seems increasing, in spite of local and global agendas to curb it, and because it directly impacts resources, environment, health, welfare etc.

It has become one of the most critical environmental problems facing mankind. While, safe disposal of waste has been a problem, the increase in the varieties and total quantities of such wastes generated in recent years and the enhancement of our knowledge and understanding of the adverse impacts of wastes on human and the environment have meant that, waste management has progressed towards the top of any environmental agenda of the present time<sup>3</sup>. So in order to have a clean environment one has to have a systematic refuse management package, and today, the urban and rural local bodies are thinking about the scientific method of solid waste management.

In this background, the present study seeks to address the following research questions;

1. What is the amount of waste generation in the Arppukara Panchayat per day?
2. What are the kinds of waste collected?
3. What are the methods of collection of Solid Wastes?
4. Who are the agents involved in the process of waste collection?
5. How much money is spent for the collection of wastes?
6. Is there any segregation of wastes?
7. How much money spent for the transportation of wastes?
8. What are the methods of disposal of solid wastes?
9. How much it costs?
10. What are the negative externalities, associated with the management of wastes?
11. Is there any other agent involved in the issue of waste pollution in the Panchayat, to add the problem of negative impacts?
12. If so how they manage their wastes? And what are the nature and extent of waste pollution by it?

### **Objectives Of The Study**

The study on 'Solid Waste Management of Arppukara Grama panchayat of Kottayam District' has two specific objectives. They are

- I. To analyse the quality and quantity of solid waste generated in Arppukara Panchayat. And
- II. To assess the major impacts of solid waste pollution in this Panchayat.

### **Methodology and Sources of Data**

It is basically an interdisciplinary topic of research, as knowledge from various disciplines converges. The study is associated with the control of generation, storage, collection, transfer and disposal of solid wastes in accord with the best principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations and that is also responsive to public attitudes.

This study is based on secondary data as well as primary data. A sample survey was carried out as part of the study. The survey was conducted during

November-December, 2004. The area of the study is confined to ward `7' of the Panchayat, which is the main waste generation point of the Panchayat. The study area is spread over 2 sq. km in the township.

The survey was completed in thirty days time. Information was collected through an unstructured questionnaire. It was decided to choose a sample of hundred families out of five hundred families for the purpose of the survey. On the basis of the survey, one could identify the stake holders, evaluate their attitude, understand their concerns, probe reasons for conflicts and consolidate the suggestions offered to improve the situation. The identified stake holders were the following.

1. The president of the Panchayat
2. The ward member
3. Concerned officials: Panchayat Secretary, Health and
4. Sanitation Staff and Contingent Labourers
5. Environmental organizations and voluntary agencies Media
6. People residing in the vicinity of dump yard.
7. Waste generators: like shop owners, Hotels and restaurants, the Medical College hospital, clinics and laboratories, households, rag pickers and beggars. Besides these Panchayat records and reports, constitute an important primary source of the study.

The secondary sources include the published material in the form of case studies, discussion papers, essays on waste management and environmental pollution control, Panchayat development report of Arppukara Grama Panchayat etc. besides some important theoretical works in waste economics. As part of the methodology, simple stratified tools have been used.

### **Solid Wastes**

Definition: Solid Waste may be defined internationally as the non-liquid waste materials arising from domestic, trade, commercial, industrial, agricultural and mining activities and from public services.

Solid Wastes are all the wastes arising from human and animal activities that are normally solid and are discarded as useless or unwanted. It is composed of a broad array of materials discarded by households, business, industries and agriculture. Not all solid waste is actually solid. Some semi-liquid and gaseous wastes are included in the definition of solid waste. The Resource Conservation and Recovery Act of 1976

(RCRA) defines solid waste to include, garbage, refuse, sludge from municipal sewage treatment plants, ash from solid waste incinerators, mining waste, waste from construction and demolition and some hazardous wastes.

R.C.R.A defines and establishes regulatory authority for hazardous waste and solid waste. According to the act, some hazardous waste may be disposed of in solid waste facilities. These include, hazardous wastes discarded from households, such as paint, cleaning solvents, and batteries and small quantities of hazardous materials discarded by business and industry.

The materials in Municipal Solid Waste (MSW) are discarded from residential, commercial, institutional industrial sources. The materials include, plastics, paper, glass metals wood, food and yard waste; the amount of each material is evaluated by weight or volume. The distinction between weight and volume is important, when considering such factors as land fill capacity. For example, plastics accounts for only about eight percent of MSW by weight, but more than 21 percent by volume conversely glass represents about seven percent of the weight and only Twenty one percent of the volume of M.S. W.

Solid Wastes are an index of our life styles, the wastes from most infra-human levels are biodegradable and hence recyclable. Solid Wastes are more an urban and much more a metropolitan problem.

A solid waste is any discarded material that is abandoned by being disposed of, burnt or incinerated or else by being accumulated, stored or treated before it is abandoned. For example, it may be yesterdays news paper, junk mail, food stuff, skin leather, fish racked leaves, dust, grass clippings, broken furniture, abandoned materials, animal manure, sewage sludge and industrial refuse or street sweepings etc.

According to S.G. Misra and Dinesh Mani<sup>2</sup> Solid Wastes are unwanted materials disposed of by man, which can neither flow into streams nor escape immediately into the atmosphere. These no-gaseous and non-liquid residues result from various human activities. These cause pollution in water, soil and air.

The term solid waste is a statutory term that encompasses among garbage refuse, or sludge from a waste treatment plant, water supply treatment plant or air pollution control facility or other discarded material including solid and semi-solid materials resulting from industrial operations, commercial mining, agricultural operations and community activities. Solid Waste is the term now used internationally to describe non-liquid waste materials arising from domestic trade commercial, industrial, agricultural and mining activities and from the public services.

The disposal of solid waste is only the most visible aspect of the waste disposal crisis. There are increasingly limited disposal options for all the solid waste generated. In response to this crisis, 'Environment Protection Agency' (EPA) introduced a waste management hierarchy in 1989. The hierarchy places, source reduction and recycling above incineration and land filling as the preferred options for managing solid waste. With progress in industrialization and consequent organization, not only has the quantity of solid waste increased, but it's quality has also changed. Though rural wastes continued to be made up of domestic wastes, and agricultural residues, mainly, wastes from the urban areas and the industrial units contain diverse types of materials which include toxic and hazard materials.

Solid wastes are generated because of human activities. A country which is highly active in terms of industry and agriculture generates considerable solid wastes of diverse types.

### **Classification Solid Waste**

- |   |   |
|---|---|
| 1. Garbage                                    | : Putrescible (decomposable) wastes from food, slaughter houses canning freezing industries and market refuse.  |
| 2. Rubbish                                    | : Non-putrescible wastes like paper, wood, cloth, rubber, leather etc. Which are all combustible? It also includes non-combustible like metals, glass, ceramics, stone etc. |
| 3. Ashes                                      | : Like fly ash from thermal plants, residues of combustion of soil fuels, or residues of incineration of solid wastes by municipal bodies or industries.                    |
| 4. Hospital refuse                            | : Cotton, plaster, ampules, needles and operation theatre wastes.   |
| 5. Large Wastes                               | : Debris from construction site, old furniture, automobiles.  |
| 6. Dead animals                               | : House hold, veterinary hospitals and zoo 26   |
| 7. Sewage treatment process solids or sludge. |   |
| 8. Industrial Solid Waste                     | : Chemicals, Paints, Sand etc.  |
| 9. Mining Wastes                              | : Tailings, Slag heaps  |
| 10. Agriculture Waste                         | : Farm animal manure, crop residue etc.   |

### **The sources of such wastes are**

- a. Municipal - street sweepings, sewage plant wastes
- b. Domestic
- c. Commercial (offices)

- d. Industries
- e. Mining and
- f. Agriculture

Solid wastes are the most visible form of pollution. Most of the methods of disposing them poses serious damage to environment and hence solid waste management should be effectively handled. It is a global problem like air pollution and water pollution and no country on earth is spared of this problem.

Disposal of such solid wastes pose a major threat. The problems of solid waste arise at three stages: 1. collection, 2. transport and 3. Disposal. Collection problem and transportation problem are closely linked. The type of containers, in which the wastes may be stored, before they are transported, the loading/unloading provisions of the vehicle and the speed of the vehicle etc are crucial. Disposal is even graver a problem, because it leads to either land pollution if dumped in land fills, water pollution if dumped in oceans and air pollution if burnt.

**Chief methods of disposal of solid wastes are,**

- 1. Dumping in land fills
- 2. Incineration
- 3. Using a cattle and hog feed
- 4. Pyrolysis
- 5. Controlled dipping and sanitary land fills

- 1. Land Filling:** Many countries have made a start by locating land fills to dump solid wastes. In the U.S. eighty percent of solid waste are dumped into 6000 land fills. But the land fill sites pose potential threat of pollution to ground water resources. Hence as land fills reach capacity, new sites have to be located, which have become scarcer.
- 2. Incineration:** It is a very hygienic way of disposal of rubbish. It requires a well designed incinerator, that would ensure, complete combustion.
- 3. Dumping:** Dumping in seas is not upheld today because of the threat it poses to aquatic life and their regenerative capacity. New York still dumps it's wastes in Atlantic Ocean. Nearly three million tones of hazardous wastes have been transported form the U.S and Western Europe on ships to countries in Africa and Eastern Europe.

4. **Hog Feeding:** It was in practice until mid 1950s when the spread of a virus disease of hogs led many countries to regulate disposal of solid waste management through this means.
5. **Pyrolysis:** It means an operation using intense heat to cause chemical changes, but not combustion. Pyrolysis may yield marketable products. For example, pyrolysis of discarded rubber tyres yield two petroleum products.

#### **ARPPUKARA GRAMA PANCHAYAT**

The case study on Solid Waste Management of Arppukara Grama Panchayat of Kottayam district aims at, analyzing the quality, and quantity of solid waste generated in the panchayat, through an assessment of environmental and human health damage, occurring in the region.

The study is concentrated on ward 7 of the Panchayat, which are the hot spots of waste pollution in the Panchayat. This study area is North-Eastern CORNER of the Panchayat. It covers an area of 2 sq.km with an average population of 4000 (1991 census). It is a small town, generally known as 'Arppukara'. It has all the facilities of an urban centre and enjoys the status of an urban region. It is here that, one of the five government medical colleges in Kerala, Kottayam Medical College, the apex medical institution in the district is situated. As far as Arppukara Grama Panchayat is concerned, Medical College hospital and its consequent growth of externalities including various commercial and business activities constitute the major source of waste pollution and this fact makes the study area, the pollution impact zone. The survey is conducted on the basis of an area view from macro view to micro view. However, before going to survey analysis, it is necessary to give a background to the Panchayat.

Arppukara Grama Panchayat, Came into existence in 1953. The Panchayat located at 6 km. North of Kottayam town, is a water-logged area. Nearly, half of the area is water logged and more than one-fourth is 'Padasekharams' (Polders). The Panchayat has an area of 24.53 sq.km and according to 1991, census, the population was 21,584 (Panchayat Development Report). The Panchayat consists of 13 wards. It is a part of Kottayam Taluk and it consists of 'Arppukara' 'Kaipuzha' 'Perumpaikadu' and 'Vechoor' villages.

The nearby Panchayats are, 'Kumaranalloor' and 'Athirampuzha'. The boundaries of the Panchayat are

At South	—————>	Meenachil River
At North	—————>	Pennar River and Kaipuzha River
At East	—————>	Panikkankunnu

At West —————> Vembanadu Lake

As far as waste is concerned, Arppukara town produces bundles of waste, due to her urban nature and consumer culture. These wastes ultimately create diseases within the Panchayat and it will spread to other areas. So it is dangerous, if the waste is not reduced. The waste is the ultimate causal factor, behind the environmental degradation and health problems. The wastes are such that, they are originated from public places, hospital and waste water from latrines, from hotels and from their activities. They are playing their best role in creating and spreading diseases. The effective steps can be taken only through the participation of the people, suggestion with regard to its is that, from our house onwards, the environment should be treated in a clean way. The use of waste management programme is now at focus because, of the environment and diseases. For better public health, and keeping the ecology of nature, it is essential, because the development of an area is based on the ability and capability of inhabitants, which are directly related to their health and existing environmental conditions.

The active waste appears in the town from the medical college hospital, and it's allied activities from clinics and laboratories, from hotels and restaurants, and from houses and business establishments and other peripheral areas of the Panchayat. During monsoon season, due to the depletion of surface soil, due to degradation process, the surface soil pass through the drainage and the drainage system will not work. When the monsoon is over, the waste water cannot pass though. This will create bad smell and diseases. That is the liquid wastes are more harmful than the solid wastes, in the case of Panchayat. This is more accurate the case of solid and liquid wastes generated from the Medical College hospital and it's allied activities, which contribute one of the major sources of waste pollution in the town and the Panchayat as a whole.

As the Panchayat is concerned, they take several *effective steps* to reduce the wastes. The above mentioned liquid waste is to be properly disposed of. The Panchayat can take the proper disposal through effective man power works. The drainage should be cleaned annually, by the worker's participation. The sediments, accumulated in the drainage can be properly displaced and dumped into barren lands of the Panchayat, that is it can be used for land filling the economics of the waste.

The trend of consumerism emerged in the town, along with the rapid increase in population and urbanization. The dynamic growth of urbanization was due to the emergence of medical college hospital in the area. Earlier it was an

underdeveloped area, having poor infrastructural facilities with traditional and subsistence farming. When the hospital started its activities in a large scale during 1980s, the region emerged as a dynamic growth pole of the local economy. Availability of infrastructure, employment potential, recreational and educational facilities and growing trade and commercial opportunities, led as the casual factors behind urban growth, and such things generated more waste per capita in the town. The Panchayat's responsibilities include the collection and disposal of solid waste, as well as the sweeping of roads, cleaning activities, etc. The domestic wastes from households, shops and other commercial establishments are dumped in the open premises. For removing these wastes, manual work is done. The disposal of wastes is carried out during night and is done manually. Segregation of wastes at points of generation is not at all carried out. However it is found that only about 58.8 percent of the total solid waste generated is collected. The main reason for the low level of waste collection are inadequate institutional capacity, the poor financial situation of the town, and the lack of proper disposal site. The quantity of solid waste generated per day and the Panchayat's collection efficiency has shown in table 1.

For doing sanitation works, including, sweeping, cleaning activities etc. the Panchayat has a staff of one sanitary inspector, and two cleaning activists-one male worker and one female worker. The service of an antimosquito worker is also getting to the Panchayat.

**TABLE 1**  
**THE TOWN'S DAILY WASTE GENERATION & COLLECTION (IN TONES)**

TOWN	SOLID WASTE		COLLECTION EFFICIENCY
	Generated	Collected	
Arppukara	4.5	2.646	58.8%

Due to lack of public awareness, the domestic and commercial wastes are simply thrown in open places like road sides, and public places. These areas form the breeding sites of many disease vectors like flies, and rats. It creates aesthetic problems. During rainy season, the overflowing drainage water is mixed with the wastes accumulated on the road sides. Also when the leachate from the refuse dump enters the surface of ground water, it may pollute the ground water. So the local governments recognized the need for urgent programme.

#### 4.1 Experiences in Arppukara Panchayat

The quantity and quality of the wastes generated from various sources, depends upon several factors such as socio, economic and cultural aspects and developmental status of the area, and also upon the life style of the people. The study area-ward 7 of the Panchayat, is the most socially, economically and culturally developed centre of the Panchayat. About 85 percent of the people residing here enjoy a better standard of living.

People belong to high income group	—————→	25%
People belong to middle income group	—————→	65%
People belong to low income group	—————→	10%

Majority of the people here are engaged in business activities. This includes, running of hostels, hotels are restaurants, shops and other business establishments etc. Besides these, almost all households here is also a hostel, affording an average of 10-20 students, who are the students of nearby medical institutions and each will get an amount ranging from, Rs. 1200-1500 a month. The increased accessibilities of health care institutions, educational institutions, public offices, public places such as bus stand. Lengthy and sound networks, Lodging facilities, recreational facilities all these contribute to the shaping of an urban centre. Because of these various business activities, a local economy is evolved within the region and all the money transactions flow within it's boundaries, and the area has been got economically and socially developed. Due to this growing and dynamic urbanization pattern, the cultures of the local people have also been changed. Now along with the increased purchasing power of people, the trend of consumerism dominates every sphere of life and consumerism gave way to increased waste generation in the town.

Now-a-days, one can see an increasing trend of replacing paddy fields and other agricultural lands, which were productive once into plots for building houses, establishing shopping complexes, hotels, hostels, clinical laboratories etc. The land here is very costly, because of the urbanization pattern and consequently the rental services too are costly.

All the developmental activities are the end result of the establishment of medical college hospital in Arppukara. The hospital came into existence in 1962 and started it's activities in 1970. The medical college hospital and it's allied activities contribute the lion share of income to the Panchayat.



7.	Medical College Vocational Higher Secondary School	1
8.	Ladies Hostel	11
9.	Neethi Medicals, run by Hospital development society	1
10.	Lab by District Co operative Society	1
11.	Other clinics and laboratories	8
12.	Scanning centre	1
13.	Indian Coffee house	1
14.	Milma booth	1
15.	Canteen	1
16.	Hotels and Restaurants	26
17.	Shops	27
18.	Lodge 2	2
19.	Arts School	1
20.	Library	1
21.	Anganvadi	1
22.	Postal and telecom offices	1
23.	Arppukara temple	1
24.	Chappel	1
25.	Muslim church	1

Besides these various types of quarters are also established in the ward according to the professional category of the employees of the Medical College Hospital. These include,

`B' type quarters : Associate professors and Assistants  
`C' type quarters : Lectures and Tutors  
`D' type quarters : Technicians. And  
`E', `F' type quarters : Last grade employees

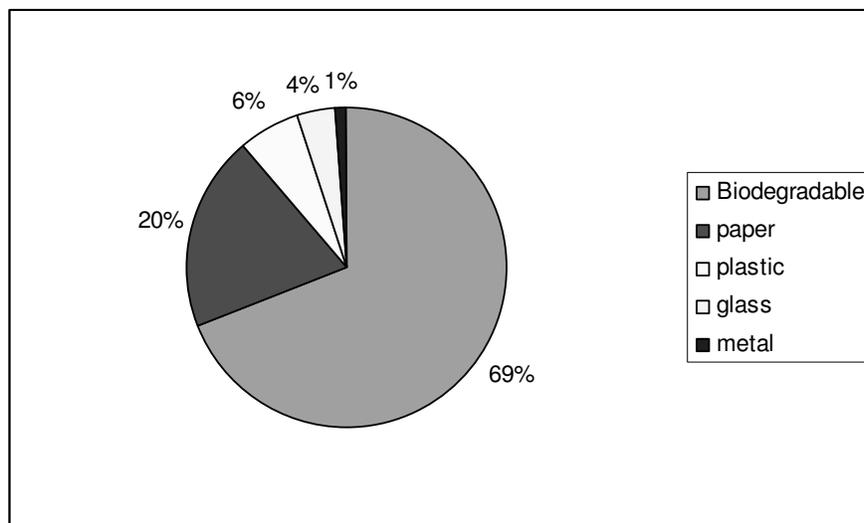
Among these quarters, `A' type which is for departmental heads and `C' type for N.G.Os are in Kumaranallor, and Athirampuzha Panchayats respectively. All these institutions and establishments produce large quantity of solid and liquid waste daily.

#### **Solid Waste Management: Present Status**

The Solid Waste generated in Arppukara town consists of biodegradable components and non-degradable components like, paper, plastics, metals, glass

etc. The daily average generation of solid waste here is estimated as 5-6 tonnes. The main waste generation points include household sector, medical college hospital, clinics and laboratories, hotels and restaurants, hostels, shops and other business establishments, educational institutions, government offices etc. The domestic waste generation is about 867 kg per day. The waste generated by shops, and commercial establishments is estimated as 0.5 tonnes per day. The hotels and restaurants generate about one tonne of degradable waste per day. The hospital and clinical laboratories generate both infectious and non-infectious wastes which come about 6 tonnes a day. The other sources of waste generated in the town are offices, educational institutions etc and their daily generation is estimated as 100 kg. About 60 percent of the total waste generated is found organic substances, suitable for composting. The characteristics of Municipal Solid Waste (MSW) in Arppukara, are analyzed

### Characteristics of Municipal Waste (MSW) in Arppukara Town



### Generation of Solid Wastes

#### 1. Household Wastes

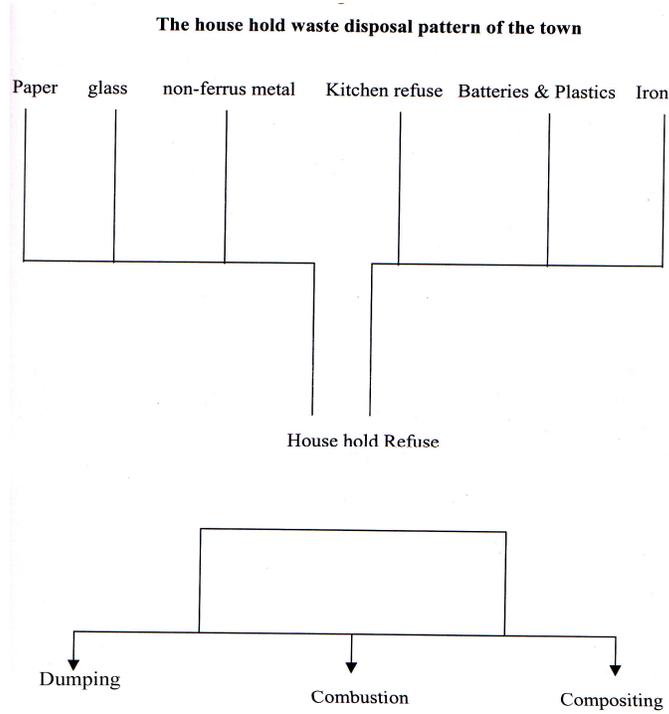
The study area consists of a total number of 600 families, with an average of five members in each family. About 90 percent of the total area comes under residential area. The quantity and quality of wastes generated from households varies, according to income, food habits, age, life style, educational and occupational status. The average generation of waste from a household is found to be 0.289 kg per person per day. The total waste generated is estimated as about 867 kg per day. These include, vegetables, fruits wastes, left over food, fish and meat wastes, paper, plastics, metals, glass etc. From the survey what one can understand is that there is no conscious practice for the disposal of household waste. Most of the households-about eighty percent, simply throw any their waste outside their home premises, and only a small proportion is deposited in a pit. More than 20 percent of the households dispose of their wastes either by burning them in their own premises or consciously convert it into manure. Since most of the households here provide hostel facilities too, degradable wastes are most produced. It is estimated to a quantity of about 500 kg about 61 percent, a day. Most of the non-degradable items such as paper plastic, metals, glass etc are collected by the rag pickers and this comes about 40 percent of the total waste generated. The rag pickers sell these wastes to the wholesale waste collectors, who transport them mainly to Salem and Coimbatore in Tamil Nadu, for recycling. Others are merely thrown back yard and heaped here and there.

Some women are engaged in cover making activities, which is done by making use of the waste papers. They sell these covers to shops for 50 ps. each. In this way, they are making 25-50 covers a day. However any kind of residential association or neighborhood activities are not at all working in the area for a proper waste management programme. In short, the household wastes are not collected at present, they are treated by itself. Nearly half of the households do not have any arrangements for disposal of waste water, and those who have any drainage facility, are very small. Composition of Solid Waste generated from households is tabulated in the table 3.

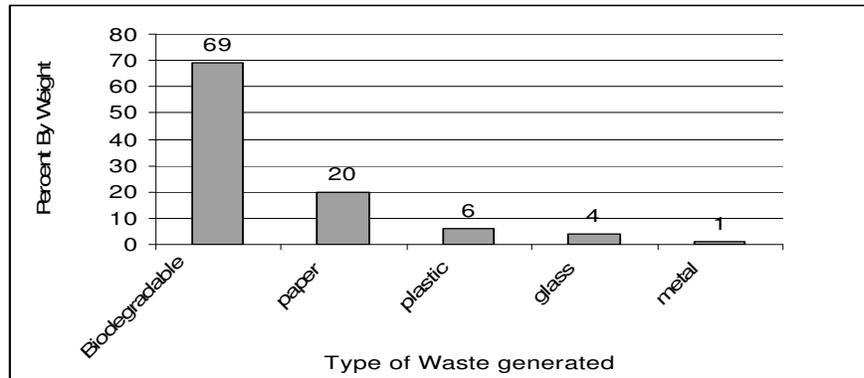
**Table 3.**  
**Composition of Solid Waste generated from House hold sector**

Types of waste generated	Percent by weight
Kitchen by Refuse	69
Paper	20
Plastic, Batteries	6
Glass	4
Metal	1

The house hold waste disposal pattern of the town is represented in the following fig  
4.2.2.



**Figure**  
**The solid waste disposal particle in the house hold sector**



### Shops and other commercial establishments

Shops and other business establishments constitute a major share of the solid waste pollution in the town. More than seventy business establishments are spread over the town. All these commercial establishments together contribute a total quantity of 1.5 tone of solid waste per day in the town. The average waste generation per day is estimated as 19.69 kg.

Daily average generations of wastes by shops and other commercial establishments are given table number 4.

**Table 4**  
**The daily average generations of waste by shops and other commercial establishments**

Sl. No.	Shops/other business units	Number of units	Daily generation of waste
1	Medical Shops	10	12 kg
2	Textiles	3	15 kg
3	Opticals	2	18 kg
4	Fruit Shops	5	75 kg
5	Vegetable Shops	4	50 kg
6	Lab & Clinics	8	16 kg
7	Hostels & Lodge	13	200 kg
8	Hotels & Restaurants	26	1100 kg
9	Bakery	3	15 kg

10	Others	17	85 kg
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Source: *The Waste assessment survey*

Medical shops, textiles shop, opticals etc. produce more of non-degradable waste. Vegetable and fruit shops, bakeries, hotels and restaurants, hostels etc produce more of degradable waste. The clinics and labs generate some infectious waste too into the main solid waste stream. There exists no mechanism for segregation of wastes generated. Bins are not provided for the disposal of wastes. Majority of the waste heaped on street sides at fixed points. The waste generators are generally indifferent to its disposal and they usually throw it indiscriminately into the streets and on road sides.

Hotels and restaurants mostly generate bio-degradable wastes like left over food items, vegetables, fish, meat etc. There are about 26 hotels and restaurants in the area. The average waste generation per hotel and restaurant comes around 42.31 kg. per day. There fore total waste generated is about 1.2 tones per day. Most of the hotels and restaurants dump their waste on the streets or in nearby rivers, canals, ponds etc. Some other give these wastes to a piggery which is situated one kilometers away from the hotels. The waste water is generated from hotels, restaurants, etc by washing vessels, and other utensils, and from toilets. It is estimated that, a total of 2, 21, 200 liters of waste water is generated from these hotels, Lodges, hotels and medical laboratories per day.

### **Other Sources**

The other sources of waste generation include, educational institutions, public offices, construction site, marriage halls, road sweeping etc. Total quantity of waste generated is estimated, around 1 tonnes per day. Waste generation from marriage halls is seasonal. Hawkers and rag pickers are found in all parts of the town. Mostly women are engaged for the collection of non degradable materials. Their sources come mainly from house holds, offices, public places and shop centres and also from the dumping place itself. The items they collect generally consists of paper, scrap materials, cans, plastics, glass, cloths, leather etc. The sorting of the collected waste materials is carried out either at the collection site or at some other convenient places. These collected materials sell to merchants.

The street vendors leave their wastes in the places where, they operate making the whole area unhygienic, besides blocking the sewage and drainage quite

often. Most of the house holds wastes are thrown indiscriminately into the street. The floating population converging on public places also throws the refuse here and there. There is no properly kept bin anywhere in such locations. The rag pickers and beggars often unload wastes from heaps for retrieving `edible' thing and leave them dispersed, attracting dogs, birds and other scavengers around them.

### **Collection and disposal of Solid Waste**

The Collection of Wastes is confined to an area of 2 sq.km. township. The Panchayat collects weekly from the point, where wastes are allowed to accumulate. It is a place behind the Panchayat bus stand and these wastes are from trade and community centres within the town. Domestic wastes are not collected at present. There is a sound road network in the collection zone. Bins are not provided anywhere in the town for on-site waste collection. Wastes are also heaped on road sides at fixed points and are burnt partially.

No plant has been established in the Panchayat, for the treatment of solid waste generated and collected. People residing in the town are reluctant to accept treatment plant in their locality. The traders in the town are generally indifferent to the programme. They believe that the collection and removal of waste is the responsibility of the Panchayat and they have nothing to do with it. The Hospital collects and disposes a part of the infectious waste by making their own arrangements.

For the collection and removal of solid wastes generated in the Panchayat, the Panchayat had its own cleaning activists. They worked, on a daily wage of Rs. 91. Because of these low wage rates, they were reluctant to do these activities and now the collection and removal of wastes is carried out on a contract basis. The Panchayat give tender to private agencies for its waste treatment programme. The practice of collection and disposal of Municipal Solid Waste (MSW) has been undertaken weekly. The expenditure incur by the Panchayat for its Solid Waste Management Programme ranges from Rs. 5,000 to Rs.10, 000 per month. The collection and removal of waste in the Panchayat is done manually and the work efficiency is very low-60 to 70 kg per person per week. The collection efficiency of the Panchayat is around 58.8 Percent. The main reasons for the low level of waste collection are inadequate capacity, the poor financial situation, of the Panchayat and lack of proper disposal site.

There is no segregation of waste at points of generation is carried out due to lack of proper people's participation. Segregation of waste at source could be successful if properly implemented. The major portions of the wastes collected are non-biodegradable. Majority of the organic wastes is at present not collected properly. They are lying on the roadsides, especially on the side of lanes and by-lanes.

The Panchayat has not fixed land fill site of its own, for its solid waste disposal. Actually, it is not directly taking part in the process of M.S.W Management. It gives tender to private agencies to collect and remove the wastes from various accumulation centres. They collect these wastes, and dump it into the river bank or in any other isolated areas in the neighbouring Panchayat during the night-between 11 p.m. and 4 a.m. earlier, the wastes removed to the residential areas within the limit of the Arppukara town. However, the local people who were severely affected by the environmental pollution, caused by the putrefied waste dumped just in front of their houses, formed a local action group and started an agitation against the dumping of wastes in the locality. At present the Panchayat is dumping the waste in a private land in Kumaranallor Panchayat. This is an abandoned paddy land and is more or less isolated. The site is located about 1.5 km far away from the centre of Arppukara town. This tendency of waste dumping in the neighbouring Panchayat often invites severe protest both from the part of concerned Panchayat and the local people.

Wastes are transported generally in open trucks. The sanitary workers transfer the waste from the road side into the vehicles manually. Each vehicle makes only one trip a day. The work consists of a total number of 3 men. Both organic and inorganic wastes are dumped together into the dump yard. In this process sanitary aspects are seldom looked into.

The wastes are dumped in the open and these wastes accumulate into huge heap, provide room for rodents to multiply, lead to fly breeding and also foul smell, which cause severe environmental pollution. Also during rainy season, the seepage water start affecting the water quality of the wells in the nearby areas and these facts give rise to severe objection from the part of the local people. The people residing in the vicinity of the dumpsites are noncommittal.

The survey reveals that, all stake holders, show more or less a strong tendency of throwing waste carelessly in the open space. It also brought out their dissatisfaction with the existing collection system of waste in the Panchayat. Burning of wastes at source point is a tendency noticed in the survey, which needs to be curbed, especially in the case of plastics, the disposal of which still remains a

difficult problem. Nevertheless almost everybody was unanimous in their opinion that the present system of waste management is quite inadequate and needs improvement.

In the wake of unprecedented incidence of 'Viral Hepatitis', in the vicinity of Medical College hospital and in the district as a whole, the State Government recently announced a course of action to be implemented in a time-bound manner, to control the spread of the disease. As part of it, the Hon: Chief Minister of Kerala has sanctioned a Project of Municipal Solid Waste Management to be implemented in the Arppukara Panchayat in 2005. The design for the proposed project would be implemented soon. This has entrusted the president of the Panchayat, to find a suitable land fill site in the Panchayat for the safe disposal of it's waste. The proposed project will be implemented by the panchayat in associated with the district Pollution Control Board and the Clean Kerala Mission.

For the treatment of liquid waste generated from the various parts of the area, the government has also announced steps to establish a waste water treatment plant in the nearby Kumaranallor Panchayat, which is just about 1 km away from the centre of Arppukara town. The expenditure for the treatment plant will be shared by the three tired Panchayats, the Pollution Control board and the stake holders.

The proposed cost estimation of the Waste Water Treatment Plant is given as

Total estimated cost	Rs. 35 lakhs
For land acquisition	Rs. 6 lakhs

Out of the total expenditure, 60 Percent will be beard by the three tired Panchayats 20 Percent by the Pollution Control Board and the rest 20 Percent by he stake holders. Among the three tired Panchayats, the distinct Panchayat will provide Rs.5,00,000, 11 Block Panchayats will provide a total of Rs.5,50000, the 74 Grama Panchayats, Rs.8,88,000 and the 4 municipalities a total of Rs.2,00000. The per day expenditure of the plant is estimated as Rs.1405, and this amount will be beard by the various institutions in the vicinity.

The total Expenditures incurred by the Panchayat, for its total sanitation and drainage activities during 2004 are given below.

**Particulars Cost incurred**

Control of epidemics	:	Rs.1,07883
Anti-mosquito activities	:	Rs.60,000
Cleaning activities	:	Rs.74,200
Sweeping	:	Rs.53400

Solid Waste Management	:	Rs.1,60000
Contingent	:	Rs.4,65483

### Medical Wastes

As far as medical waste is concerned, Medical College hospital is the main source of generation. It generates large quantities of both solid and liquid wastes per day. This includes both infectious and non- infectious wastes. The total quantity comes around 6 tonnes per day.

The total quantity of waste generated in Kottayam Medical College is furnished in the Table 5.

**TABLE 5**  
**THE TOTAL QUANTITY OF WASTE GENERATED IN KOTTAYAM**  
**MEDICAL COLLEGE**

Kottayam medical college Category of hospital wastes	Quantity per day
Clinical waste	2616 kg
General waste	3000 k
Plastic waste	558
Radio-active waste	1 kg
Total	6175

*Source: District Pollution Control Board, Kottayam 2003*

### Categories of Hospital Waste

Hospital Waste is classified according to the Bio-medical w (Management and handling) rules 1998, into the following categories as show the table number 6.

**TABLE 6**  
**CATEGORIES OF HOSPITAL WASTE**

Opinion Category No.1	Waste Category	Treatment and disposal
	Human anatomical wastes(human tissues, organs, body parts)	Incineration or deep burial
	Animal Waste, including animal	Incineration or deep

No.2	incinerations or deep burial tissues, organs, body parts, carcasses, parts, fluid blood and experimental animals used in research waste generated by veterinary hospitals, colleges, discharge from hospitals, animal houses etc	burial
Category No. 3	Micro biology and Biotechnology waste (Wastes from laboratory cultures stocks or specimens of Micro organisms, live or attenuated vaccines, human, and animal cells, culture used in research and infections agents from research and industrial laboratories, wastes from production of biological toxins, dishes and devices used for transfer of culture.	Local auto claving or micro Waving or incineration.
Category No. 4	Waste sharps (Needles, syringes, scalpels, blades glass etc. that may cause puncture and cuts. This includes both used and unused sharps.	Disinfection (chemical treatment autoclaving, microclaving, microwaving and mutilation shredding.
Category No.5	Discarded medicines and toxic drugs (Waste comprising of out-dated, drugs disposal in secured land contaminated and discarded medicines)	Incineration or destruction drugs disposal in secured land fills.
Category No.6	Items contaminated with blood and body fluid, including cotton dressings, soiled plaster casts, bedding, other material contaminated with blood.	Incineration@autoclavin or microwaving
Category No.7	Solid waste (waste enerated from disposable items, other than the waste harps, such as tubins, (athters, intravenous sets etc).	Disinfection by treatment@ autoclaving or micro wavin and multilation or shredding.
Category 8	Liquid waste (Waste generated from laboratory and washing, cleaning, house keeping and disinfecting activities)	Disinfection by chemical treatment and discharge in to drains.

Category 9	Incineration Ash (ash from incineration of any Bio medical waste)	Disposal in municipal land fill
Category No 10	Chemical waste (Chemical used in production of Biological, chemicals used in disinfection as insecticides etc.	Chemical treatment @ and discharge in to drains for liquid and secured land fills for solids.

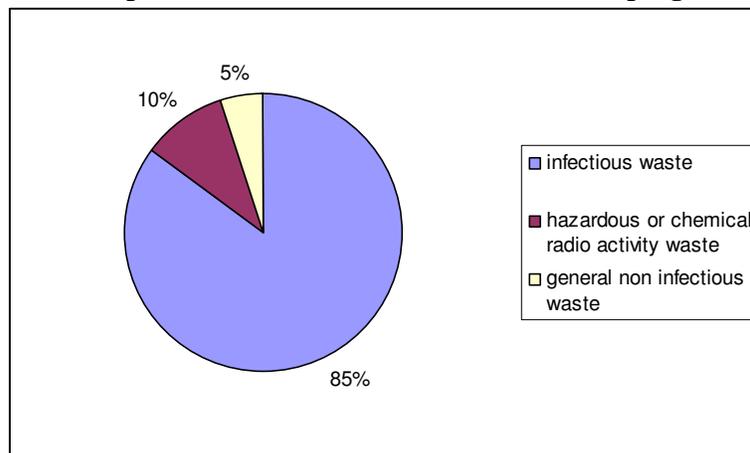
Source: Gazette of India Management and Handling Rule 1998

Each type of hospital waste has different nature, and varying levels of risks attached to it. Rule 4 of the Bio-medical waste (Management and handling) rules 1998, says that, it shall be the duty of every occupier of an institution generating bio medical waste which includes a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank, by whatever name called to take all steps to ensure that such wastes are handled without any adverse effects to human health and the environment.

### Components of Health Care Waste

The following figure shows the various components of health care waste in developing countries.

**Fig. 3**  
**Various components of health care waste in developing countries**



Source: WHO Publication Medical Waste in Developing Countries 2002

The hospital wastes can't make any kind of recycling units, because, these elements are disease bearing. So it will be used for burning. For the burning, what is needed is the furnaces. So hospitals, including government and private hospitals, construct furnaces, and on account of the disease borne urban solid waste. The furnace having it's standard size that is to keep it's potential while considering it's size. Now the central government passed separate policies regarding the case of hospitals. The item mainly concentrated on the construction of furnaces. Government of India's environment ministry passed the policy regarding the disposal of wastes. Their studies cited that the extra materials after use from hospitals create both environmental and human problems. They introduced four policies and they published it.

The solid and liquid wastes from hospitals act as a burden to the environment. So, on this basis, the government took necessary steps in August 2002. The first among the 4 are the medical waste management and handling rules of 1998 and their amendment of 2000, has made effective in 2002. This order was published in August 2002. It is difficult to adopt such order in Kerala because the hospitals are now not well equipped for adopting the suggestions.

According to the Qualified Medical Practician Association, there are private and government hospitals covering 72000 beds and 38,000 beds respectively. And the number of hospitals is likely to be 3800 and 1740 respectively. They produce 450 litre of liquid waste and 570 kgms of solid waste per person daily. So one can think how much the total amount per day is. For it's proper disposal, it will take about 11 to 15 lakhs investment. They argued that, it is not at all economical for them, to follow such policies. For this the government sector hospitals alone need 85 crores of rupees. The private sector hospitals now need about 190 crores of rupees.

In the case of Kerala, it is difficult to follow such policies because of it's huge cost. Now it is difficult to construct the furnaces and other infrastructures due to the density of population inside and outside the Hospital.

Medical College Hospital generates a total quantity of 6175 kg of solid waste and 5,6200litres of liquid waste per day. The bio medical waste generation is estimated as 1105 kg per day. General waste produced comes more than 4 tonnes per day, among which garbage production alone constitutes, 2.5 to 3 tones per day in effect.

**Number of beds:**

Effective bed Strength : 2200

**Capacity**

In patients : 1450

Out patients : 2000

The bio medical generation is at the rate of 0.2 kg per day per bed, in the case of inpatients and it is at the rate of 0.15 kg per day per person in the case of out patients. Thus, the average bio medical generation is estimated as 700 kg per day per bed for inpatients, and it is 405 kg per day per person, for out patients. The category and quantity of medical waste generated from Kottayam Medical College is given in table number 7.

TABLE 7  
THE CATEGORY AND QUANTITY OF MEDICAL WASTE GENERATED FROM  
KOTTAYAM MEDICAL COLLEGE

Sl. No	Category No.	Kinds of Waste	Quantity per day	Percent
1	I	Human anatomical waste	115.5 kg	7.7
2	III	Micro biology waste	15 kg	1
3	IV	Sharp instruments	307.5 kg	20.5
4	V	Discarded medicines	214.5 kg	14.3
5	VI	Soiled Waste	300 kg	20
6	VII	Solid Waste	558 kg	5
7	VIII	Liquid waste in patients out patients	5,0000 litre 35001itre 2700 litre	36.5
		Bio medical waste generation in patients out patients	1105 kg 700 kg 405 kg	

*Source: District Pollution Control Board kottayam 2003.*

The clinics and medical laboratories produce large quantity of infectious liquid waste, which is flowing through the drain and finally joins the river in the Panchayat area. This causes serious pollution problems in the vicinity. It is estimated that the clinics and laboratories demand a total quantity of 14,000 litres of water per day out of which 11,200 litres of water is discarded as waste water per day.

These medical wastes along with the mainstream solid wastes, causes serious environmental and health damages to the people living in the vicinity. The Panchayat is now facing a grave pollution problem, as the sewage generated in the Kottayam Medical College area is flowing through drain and finally joins the river in the Panchayat area. This causes, severe pollution and creates suffocation to the nearby residents due to it's foul smell. Local people were affected by diseases, due to the absence of hygiene especially lack of proper drainage or treatment system. The outbreak of a viral hepatitis on the premises of Kottayam government medical college is the immediate social cost of the waste pollution in the Panchayat.

Even if the problem of waste pollution is a crucial one, neither, the hospital authorities not the Panchayat is taking sound measures for, it's proper management. The hospital authorities are indifferent to the waste management programme and they seemed reluctant to respond to this crucial problem. The attitude of the Panchayat is that, the collection and disposal of the wastes is the responsibility of the hospital, and they have nothing to say about it. However, the majority of the solid wastes produced from the hospital, including both biomedical and general wastes are treated within the boundaries of the hospital itself.

For collection of Solid Wastes, Polythene bags are put in each ward of the hospital. These polythene covers are of Rose, Green and Yellow colours. The patients are supposed to dispose their wastes, after sorting them as food waste in one bag, paper, and plastic, etc in another bag and sharp materials in the third one. Biomedical wastes are collected separately. However the disposal of these wastes is a pitiable one. All the general wastes from the patients and biomedical waste from the hospital including, the wastes from operation theatre and labour room, are brought in an autoriksha to an open place nearby the hospital and dump all these together there and then cover it by soil. This usual practice of removal of waste causes severe pollution and it's foul smell creates suffocation to the nearby residents. These dumping places attract dogs, birds and other residues in the nearby wells and pollute the water too.

**Conclusion:**

Even though the Medical College hospital is getting the status of 'Centre of Excellence' its waste management programmes are still in a primitive condition. It is an alarming fact that, there is a single treatment plant operating at present for its waste disposal problem. The sewage treatment plant at the Medical College Hospital has not been working for the past nine years and the sewage waste had been allowed to flow into the open fields in the back on the campus. In September 2004, an incinerator costing Rs.27 lakhs was established for the management of its solid biomedical wastes. The incinerator needed large volume of diesel, for its operation, and the daily expenditure was Rs.1,00,000. As it is unaffordable, for the hospital, the incinerator is not working at present. The hospital development committee is spending huge amount of money on account of repairing the drainage blocks. The work of a proposed project of solid waste management in association with Nirmal 2000 and National Sanitation Mission is also in progress, and the cost of the proposed project is estimated to be around Rs.30 lakhs. For the treatment of the liquid wastes, the sewage plant is proposed to reestablish and the government has allowed Rs.45 lakhs for this purpose.

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