Environmental Science
Lecture 21

Sources of Urban Waste

If you go about seeing the source of our main urban waste. Primary is domestic waste which is food waste, clothes. Commercial waste is waste paper, cans, bottles, other sources with respect to urban scenario is construction wastes like wood, concrete. Then you have biomedical waste from hospitals; needles, syringes, anatomical wastes.

What happens if you don't manage your wastes? If you mix everything and throw it away in one bag, it causes diseases, has certain poisonous products which when released can actually harm animals that consume the garbage and that could add on to the littering part of it that causes pollution. Also, just because it is completely mixed, the compost part of it, the biodegradable, non-biodegradable, medical wastes, all gets mixed and because of that, a very small percentage of the material can be reused or recovered and because of using syringes, needles and glass; broken materials present cause a lot of injuries to the people who are handling the garbage. Managing our waste doesn't only refer to what happens after collected. The whole process of collection, dumping, how are we collecting it, where are we keeping it, who is going to transfer it from one spot to another spot, what kind of wastes, how are we segregating our waste, all of these fall under Solid waste management.

The different kinds of waste we are talking about are; in solid form you have domestic, commercial and industrial wastes. Examples - plastics, bottles, cans, papers, scrap iron and other trash. Liquid wastes are the detergents from washing machine, waste water from ponds, manufacturing industries and other sources. Biodegradable like paper, wood, fruits and vegetables. Non-biodegradable - which cannot be further degraded or decomposed like plastics, bottles, old machines, Styrofoam containers, computer parts, cds, all of these fall under non-biodegradable. Hazardous wastes - substances unsafe to use commercially, industrially, agriculturally, or economically and have any of the following properties - ignitability (it can catch fire), corrosivity (can corrode the materials around it) , reactivity (it will be a catalyst or can cause reactions with other garbage) and toxicity (it can make something poisonous like water, soil, whatever it comes in contact with). Non-hazardous waste as substances that are safe to use commercially, industrially, agriculturally or economically and do not have any of those properties that we just discussed. These usually create disposal problems.

How do we go about classifying waste according to their origin and type? We have Municipal Solid waste which include household garbage, rubbish, construction and packaging materials, trade refuges are managed by any kind of municipality. Bio-medical wastes are solid or liquid

wastes including containers, products generated during diagnosis, treatment and research activities of medical sciences. Industrial wastes encompasses liquid and solid wastes that are generated by manufacturing and processing units of various industries like chemical, petroleum, coal, metal gas, sanitary, paper, etc. Agricultural wastes are generally generated from farming activities, these are mostly biodegradable but they could be toxic if the fertilizers and pesticides are going to be used in abundance. E-wastes is a newly emerging waste, which is causing a lot of problems. Any modern establishment which is basically discarded electrical or electronic devices. Some electronic scrap components such as CRTs, wires, circuits, mobiles, computers, cds etc. All of these are considered e-waste. We saw household generating waste which could be both organic as well as inorganic. Industries, Agricultural waste, Fisheries waste which is in the river and seas.

If you look at sources of waste; paper and paper boat take the maximum of nearly 30% and that is the primary kind of waste. If you take a look at paper, it is a recyclable material and once recycled, it can be reused as well. Plastic takes about 13%, plastic can also be recycled to a certain extent. But what happens when waste is not managed well? Once paper gets in contact with vegetable garbage and other kinds of waste like broken glass, it cannot be processed. It is equivalent to being non-biodegradable or non-reusable. It is very important that we save 30% of this garbage which means we can actually reuse it efficiently. 30% of plastics can also be reused. Metals, 9% can be converted as scrap. Wood is also biodegradable and we have Yard trimmings. Basically plant waste, vegetable wastes from markets, is again completely bio degradable. If you look at blue, red, green; these three are completely biodegradable which is nearly 30% of paper and paper related. Food Scraps are nearly 13%, Yard trimmings are another 13%. This itself makes sure our garbage is managed well, segregated at the collection point itself, we will have to deal only with the small percentage of non-biodegradable materials. But if we do not segregate this, all of these are a complete waste and none of it can be reused. If you look at the structure of solid waste, you have refuse and Trash. Trash is bulky waste, Tv, refrigerator goods, broken furniture like mattresses, pillows etc. Refuse you have two types; Garbage which are vegetables, meats, food wastes and other readily degradable organic wastes that are usually from the kitchen. Rubbish is non-degradable like glass, rubber, metals, plastic, non-metal sets, all of that. These are slowly degradable especially paper, wood, products, textiles, even though they are considered degradable, it takes a long period of time, it will be better to segregate the completely wet garbage from the dry garbage.

If you look at Solid wastes in India, we have 7.2 million tonnes of hazardous waste, 1 sq km of additional landfill area is added every year. Rs 1600 crore for treatment and disposal of these wastes is spent, In addition to these industries discharge of about 150 million tonnes of high volume low hazard waste every year which is mostly dumped on low lying land areas.

How is the growth pattern of solid waste in India? Waste is growing by leaps and bounds and this is direct proportion to population, urban population especially. As and when population is growing tremendously, waste generation will also grow tremendously. Between 1981 - 91, population of Mumbai increased from 8.2 million to 12.3 million. During the same period, municipal solid waste has grown from 3,200 tonnes to 5355 tonne, an increase of 67%. Cities like Bangalore produces 2000 tonnes of waste per annum. Waste collection is very low for all Indian cities. Primarily by the city municipality - they are the main collectors of waste within our country. There is no gradation of waste product i.e there is no segregation. Like, Biodegradable, glasses, poly bags, paper shreds etc. All of these are not segregated, they are all put together. Dumps these wastes to the outskirts of the city. Local Raddiwalas or Kabadiwalas collect these small iron pieces by magnets, which is recycled in scrap form. Then they collect the glass bottles which are again recycled to a certain extent, then they again collect the paper for recycling. But all of this percentage for reutilisation is very small because i) the iron particles could be rusted, it could lead to a lot of infectious diseases. ii) Glass bottles - as and when it is thrown from one place to another, it breaks and that leads to a lot of harmful incidents like cutting and diseases because of this. iii) When you think about paper, they are mixed with all of these materials and 100% is obviously not going to be reused or recycled.

How has solid waste affected us in recent years? In Mumbai, in the year 2005, it pretty much clogged all of the sewer lines due to large number of plastic bags, this again causes a lot of chaos and confusion when there is heavy torrential rains and when there massive rains like these, the plastic bags block the drains and the water gets flooded onto the roads and the streets of the city. There was this blast in Gulshan's steel factory in Noida which was caused due to imported scrap from Iran. Reduction in the number of migratory birds due to the consumption of contaminated food, animals dying on streets and farmlands due to the consumption of plastic bags which blocks the food movement in their stomach. Another main problem with the collection of mixed goods in one bag is; all the animals and scavengers tear apart the plastic to reach the food they can smell. What happens is, plastic is obviously consumed by these animals, along with this, metal pieces, sharp broken glass, all of these are also consumed, tearing the intestines causing permanent damage and death.

Health Impacts of Solid Waste

If you look at the health impacts of Solid waste, Exposure to hazardous waste can affect human health children being more vulnerable to these pollutants. Improperly operated incineration plants cause air pollution and improperly managed and designed landfills attract all types insects and spread diseases. Direct handling of solid waste, results in chronic diseases with waste workers i.e people who work in these areas, they are not given any protective clothing and measures, they are just collecting all the garbage with bare feet and bare hands, which

cause a lot of health issues. If you look at landfill, it is the most traditional method of waste disposal. Waste is directly dumped into disused quarries, mining voids or borrow pits. Disposed waste is compacted and covered with soil. Gases generated by the decomposing waste materials are often burnt to generate power. It is generally used for domestic waste. The advantages of a landfill are; obviously it is a cheap waste disposal option for the local council and municipalities. Jobs are getting created for local people. Lots of different types of waste can be disposed of by landfill in comparison to the other waste disposal methods. The gases given off by the landfill site could be collected and used for generating power. Disadvantages are; it is definitely going to look ugly and as and when the population increases, the landfill also increases. Dangerous gases are given off from landfill sites that cause local air pollution and contribute to global warming. Local streams could become polluted with toxins seeping through the ground from the landfill site. Once the site has been filled it might not be able to be used for any kind of redevelopment as it becomes too polluted. Once the levels of toxicity reaches a particular level, it cannot be covered and reused as a site for construction as it will be deemed hazardous and unsafe.

If you look at the land required for disposal of solid waste and this is the emission of methane from landfill. In 1997, it was negligible and in 2047, the level in sq km is 1400 sq km for disposal of solid waste and because of that what has happened with the emission of poisonous methane gas. In 1997, it was between 5 and 10 million tonnes per year and in 2047, it is expected to reach a whopping 40. You can see there has been a steady increase and they are projecting an increase because they are not coming up with better options to offer municipalities.

If you look at the process of Solid Waste Management; obviously the first part is 'Generation of Solid Waste' i.e in homes, industries, whatever the area. Then, the waste is collected, then it is transported, then it needs to be stored. This stored portion is again a dicey situation, then it is segregated, separated for recycling and then finally disposable methods are chosen based on what is left behind. You can see a tedious process is followed but the segregation of waste should ideally happen before the collection of the waste at the very source and the collection of waste should be done in numerous channels according to the type of waste that is generated. Then, the transportation storage will all become much easier, than directly from the generation point, one transportation can go to recycling and one more set can go to alternate disposal methods depending on the material that is coming out.

Typical disposal methods are; Landfill, Incineration and Composting. Steps involved are; Solid Waste Management. Reduce, Reuse and Recycle before destruction and safe storage of wastes. Discarding wastes. First, let's reduce the generation of waste. How much ever it can be reduced, let us reduce it and the next step is;how do we go about discarding this waste. Sanitary landfill, this is a kind of an alternate landfill system where you have 80 cm thick refuse

covered with selected earth fill of 20 cm thickness. After around 2 to 3 years, the solid waste volume shrinks by 25 - 30% and the land is used for parks, roads and small buildings. A typical example of this has been done in Kotturpuram where an old landfill is now being made into a public park for the use of the general public. The most common and cheapest method of waste disposal in sanitary landfills which is invariably employed in Indian cities. But here, the key word is 'Sanitary landfill' which is done in the method described. If its just going to be an open land where everything is going to be dumped, that is not going to be considered a sanitary landfill but just landfill.

Landfill structure is built either into the ground or on the ground into which the waste is dumped. The method involves spreading the solid waste on the ground, compacting it and then covering it with soil at suitable intervals. Essentially what we are trying to do is, whatever garbage is going to be decomposed, we will provide the bacteria and whatever environment that is required for the decomposition process to fasten and get faster.

Energy consumption or energy generation from Landfills - Landfills can harness energy too. Bacterial decomposition inside landfills produce methane, the main component of natural gas. How do you go about collecting this landfill gas? Landfills can actually start making extra money, fuel is then made available and Methane which is a greenhouse gas is collected and prevented from reaching the atmosphere and affecting the nearby surroundings. What is the advantage of a sanitary landfill? It is simple and economical, segregation not required. Landfilled areas can be reclaimed and used for other purposes. Converts low-lying, marshy wasteland into useful areas. Natural resources are returned to the soil and recycled. Disadvantages - a large area is required since land is available away from town, transportation cost is heavy. Bad odours if landfills are not properly managed. The landfill areas will be sources of mosquitoes, flies and hence, insecticides and pesticides are to be sprayed at regular intervals. It causes fire hazards due to the formation of methane in wet weather. It will start like forest fire, it can self combust and create a lot of issues.
Incineration is a waste treatment process that involves the combustion of solid waste at 1000C. Waste materials are converted into ash, flue gas, and heat. The ash is mostly formed by the inorganic constituents of the waste and gases due to the organic waste. The heat generated by incineration is used to generate electric power. The steam is used to propel the turbine and that turbine instead produces electricity. What are the advantages of an incinerating method? Minimum of land is needed compared to other disposal methods. The weight of the waste is reduced to 25% of the initial value. No risk of polluting local streams and groundwater as in landfills. Incineration plants can be located close to the residential areas and the gases are used to generate power.

What are the disadvantages? Completely expensive, requires skilled labour, the chemicals released in the air could be strong pollutants and may destroy the ozone layer, that's a huge disadvantage and there is obviously a high energy requirement. The balance of energy requirement vs energy production needn't always be met.

Composting

In this method, bulk organic waste is converted into a fertilizing manure by biological action. The separated compostable waste is dumped in underground Earthen trenches in layers of 1.5m and this is finally covered with Earth of about 20 cm and left over for decomposition.

How does composting actually work? When you have an influx of oxygen, with Feedstock and Manure compost coming out as a bi product and the other products are water, heat, carbon dioxide and other such gases. What is the input? Raw manure, bedding, feed wastes, nutrients, carbon, nitrogen, water and soil and the output is; mature compost which is a uniform mixture of decomposed organic matter, minerals, micro organisms with reduced volume, weight, and moisture content and this is considered a very fertile manure which can be used for agricultural and gardening purposes.

Composting - sometimes certain microorganisms are introduced for active composting. That needs to be added on. Within two to three days, the biological action starts, the organic matters are being destroyed by actinomycetes and a lot of heat is liberated as a byproduct of this process. Finally, the refuse is converted to powdery brown coloured odourless mass known as humus and has a fertilizing value which can be used for agricultural fields. The compost contains a lot of nitrogen which is essential for plant growth apart from phosphates and other minerals. WHO has set up a compost plant in New Delhi in 1981 with a capacity to handle 90 to 100 tonnes of waste everyday. The prepared compost was supplied to nurseries, kitchen gardens and horticulture departments. The composting technology is widely used in many developing countries.

What to compost and what not to? For this method, segregation of garbage is very crucial. All food wastes which includes meats and dairy, compostable products from the Hark industry - these are a grade from decomposable plastics, they are types of styrofoam and plastic induced things that completely degenerate and decompose. Napkins and paper towels, tea bags, wooden stirrers, yard trimmings; all of these can be compost. Single used servings, that cannot be put in. Recyclable items like metal, plastic and paper; Coffee cups and lids from commercial establishments and soup lids from restaurants.

Types of composting you have; Aerobic composting, Anaerobic composting and Vermicomposting. When the manure is added to the soil, it increases water retention and the

ion exchange capacity of the soil. A number of industrial solid wastes can also be treated by composting. It can be made as manure and that can be sold which in turn reduces the cost of disposing of wastes. Recycling has to occur simultaneously.

Disadvantages - the non-consumables have to be disposed separately. In the sense, the segregation of garbage is very important. Use of compost has not yet caught up with the farmers and hence n assured market for the manure. How to go about treating hazardous wastes? Waste that poses a potential danger to human health. Four criteria are; Ignitability i.e things that can catch fire, Corrosivity - substances that can corrode metals. Reactivity - substances that are chemically unstable and react with other chemicals in dangerous ways. Toxicity - substances are known to be harmful to human health. There are many types of hazardous wastes. You have heavy metal like mercury, lead, chromium, arsenic, cadmium, tin, copper; which are from industry, mining and consumer product industries. Organic compounds like synthetic pesticides, petroleum products, rubber, solvents and preservatives. The surface impoundments has hazardous wastes, it is really only for temporary storage and is not considered ideal. Wastes may essentially overflow or vapourize or leak. All of this, is not considered an ideal situation. It is only a temporary relief to store it.

How do you go about making sure solid waste management of hazardous wastes especially is going to be done in a proper channeled manner? First is; Systematic solid waste management, involving public in plans for waste treatment and disposal. Educate people on different ways of handling their wastes. Household level of proper segregation of waste, recycling and reusability. Process and product substitution example use paper bag instead of plastic bags. Garbage collection according to the schedule that is set. Awareness, education and segregation of garbage is the first step and can actually be started at every household level, that is only very important. If Garbage is not segregated at the very source, then having any of these management plans is not going to cause any effect in the long run.

Compaction - the waste is compacted or compressed. It also breaks up large or fragile items of waste. This process is conspicuous in the feed at the back end of many garbage collection vehicles. Deposit refuse at the bottom of the slope for best compaction and control of blowing litter.

Pyrolysis is defined as thermal degradation of waste in the absence of air to produce char, pyrolsis oil and syngas i.e the conversion of wood to charcoal. Also it is defined as destructive distillation of waste in the absence of oxygen. External source of heat is employed in this process.

The three important R's - Reduce, Reuse and Recycle. You can actually help by Precycling one third of all garbage is packaging. Buy things that are in packages that can be recycled or are made of recyclable materials. When you buy something small, say no thanks to a bags. How do you go about Reusing? Many things can be reused before they are thrown out. Use coffee cans and cottage cheese containers to store it. Use backs of paper of used envelopes for jotting notes. Put leftovers in reusable containers instead of using wrap and foil. Use your old clothes as rags for cleaning instead of paper towels. Have a garage sale or donate clothes, books and toys that are not used anymore. Recycling is most crucial - every year we use about 25 billion plastic containers, 30 billion bottles and jars and 65 billion aluminium cans and 100 billion pounds of paper. All of these are recyclable materials; if all of these are properly segregated and channelized, we can make a huge saving not only in terms of money but also in terms of saving the environment.

This is the waste reduction Hierarchy - the most favorite option in this is, Reduce. Lowering the amount of waste produced. Then we have Reuse; using materials repeatedly. Then we have recycle which is using materials to make new products. Recovery - recovering energy from the waste that is generated. Landfill - safe disposal of wastes to landfill, this is considered the least favoured option.