Environmental Science
Lecture 24

Environment and Sustainable Development

What is Biophysical environment? The biophysical environment is the combined modeling of the physical environment and the biological life forms within the environment, and includes all variables, parameters as well as conditions and modes inside the Earth's biosphere. The biophysical environment can be divided into two categories; the natural environment and the built environment. Following the industrial revolution, the built environment has become an interestingly significant part of the environment as well. What is sustainable development? Economic development without polluting the environment - economic development maintained within acceptable levels of global resource depletion and environmental pollution.

Sustainable development is a pattern of growth in which resource use aims to meet human needs while preserving the environment so that these needs can be met not only in the present, but also for generations to come. What exactly does this enable? Sometimes taught as ELF or Environment local people, future. Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This was defined by Brundtland Commission. Factors affecting the environment; population growth, global warming, Ozone Layer Depletion, Habitat destruction and extinction, air pollution and water pollution.

If you look at population growth, that is one of the main aspects since the industrial revolution. As things have been developing and improving, human progeny has become faster and mortality rate has also reduced. Human population growth is at the root of all the problems, regarding the environment. Although, the growth rate of the world's population has slowed slightly since the 90s, the world's population increases by about 77 million human beings each year. As the number of people increases, crowding generates pollution, destroys more habitats, and uses up additional natural resources as well.

Global warming - Ozone layer depletion. The Ozone layer is a thin band in the stratosphere that serves to shield the Earth from the Sun's harmful ultraviolet rays. The ozone hole over the South Pole which is apparent in this false color image that has been taken by a satellite in 1999. Low levels of ozone are shown in blue. Ozone is a gas that blocks harmful ultraviolet sunlight. Industrial chemicals released into the atmosphere have cause ozone to break down, opening holes in the ozone layer that tend to concentrate especially at the poles. This is the one that is seen in the south pole, this is the Ozone layer that is continuously depleting. The consequences of continued ozone depletion would be dramatic. Increased ultraviolet radiation would lead to

a growing number of skin cancers and cataracts and also reduce the ability of immune systems to respond to infection.

Additionally, the growth of the world's oceanic plankton, the base of the most marine food chains, would decline. Plankton contains photosynthetic organisms that break down carbon dioxide. If plankton populations decline, it may lead to increased carbon dioxide levels in the atmosphere and thus adding on to global warming.

Habitat destruction and extinction - Plant and animal species are dying out at an unprecedented rate from 4,000 to as many as 50,000 species per year become extinct. The leading cause of extinction is habitat destruction. If the world's rain forests continue to be cut down at the current rate, they may completely disappear by the year 2020.

Air pollution - acid rain forms when sulphur dioxide and nitrous oxide transforms when sulphur dioxide and nitrous oxide transforms into sulphuric acid and nitric acid in the atmosphere and then comes back onto the Earth in the form of precipitation. Acid rain has made numerous lakes so acidic that they no longer support fish populations. Acid rain is also responsible for the decline of many forest ecosystems worldwide, including Germany's Black Forest. Estimates actually suggest that nearly 1.5 billion people worldwide lack safe drinking water and that at least 5 million deaths per year can be attributed to waterborne diseases. Water pollution may come from point sources or nonpoint sources.

Water Pollution may come from 2 sources; both point as well as nonpoint sources. Other factors are; Groundwater depletion and contamination, chemical risks, environmental racism, power production. Moving on to water conservation; simple water facts we need to consider before we get into the nuances of water. One billion people lack access to safe water, the average person consumes a gallon of water in a day, residential daily water use in the U.S averages 70-100 gallons. Daily water use in developing countries (Pakistan) is 20-30 gallons. Industrial and other water consumptions are high. 125 litres of water to produce 1kg of steel. 1,665 liters to make 1 kg of synthetic rubber. 766 liters for a kg of high quality book paper. The average daily water usage is as follows; 33,600 liters to raise one kg of beef, 10,935 liters to grow 1 kg of cotton and 4,200 liters to grow one kg of rice.

Wastage of water - wasting water has become a significant environmental problem, both an consumer and industrial levels. Hence, it has become important for individuals and businesses alike to find out ways to reduce the wastage of water and conserve it.

Water supply and conservation - state of the industry. Children below the age of 5 in Asia, Africa and Latin America have diarrhea - 500 million nearly. Diarrhea cases in Pakistan reaches

about 100 million annually. Hospital beds are 20 - 40% occupied due to water related diseases. Water related diseases across the globe, accounts for 80%. Deaths caused by water borne diseases is 33% and it is a fact of life that water is vital for all forms of life.

What is water conservation? Water conservation simply refers to reducing the usage of water and recycling wastewater for different purposes such as cleaning, manufacturing and agricultural irrigation. This method definitely accounts as the most efficient and cost effective way to control the use of water. Why conservation is important? Fresh water is a limited resource, but demands are increasing. Only a small percent of total water on Earth is usable without any advanced technological treatment. WE have less drinkable water every year due to contamination and increased demand. Reduces by 60 to 75% in just leakage. New Delhi added 20 million gallons just by conserving water. Why utility should focus on water conservation?

Water conservation means saving water which indirectly means reducing energy use. Reduced capital or Operational cost; Economic Stability and Growth, Enhanced Protection of the Environment, Foster Sustainability and Community Pride.

Ways to conserve water; at home, shorten your shower by a minute or two and you will save about 150 gallons per month. Monitor your water bill for unusually high use. Your bill and water meter are tools that can help you discover leaks. Grab a wrench and fix that leaky faucet. It's simple, inexpensive and you can save 140 gallons a week. The usual said thing in our country is to add on water meters even if we don't have to pay our water bill as such. Most of us pay for our water in other ways like maintenance and tankers directly. But having a water meter helps us realize our consumption. Like how we get our gas cylinders, we realize how much LPG has been consumed based on our consumption and the regularity based on when do we switch the cylinders.

Similarly we have a water meter, the way our electricity consumption is checked and paid for. If we had a similar to do so for water, it will be very helpful for us to keep a check on our water consumption. This is the new way of water consumption. Have water efficient appliances and toilets, make sure we have the classic cistern which will have rain water. Harvesting rain water from the roof is very crucial. Have a drip irrigation system. THe amount of water that goes towards irrigation is monitored and just the required amount of water. Water from either the well or any sort of system can also be used. Drought resistant garden. Ensure you do not have a vast green lawn which are complete consumers of water without giving back much. Ensure we have plants that consume water and at the same time, they have very good quality of purifying air, giving fruits, flowers, etc. Make sure we have drought resistant native plants rather than having exotic plants from other parts of the world. Make sure we have drought-resistant native plants rather than having exotic plants from other parts of the world and ensuring that our

septic tanks are separated from the ground water. The groundwater and septic tanks do not have any mixing that ensures the groundwater is not polluted or the rain water does not enter the septic tank and get wasted. If possible especially in office complexes and large residential complexes, the water can be recycled through the sewage treatment plant and that water could be used to water the lawns as well as in the flushing system in all the houses. How to identify leaks? Leaks can be identified by leak detection survey of the distribution system, Using a leak detection monitor/meter, injecting a dye in the toilet tank.

Living Green

Living Green - clean vegetables and fruits efficiently using a vegetable brush and short water bursts with the hand sprayer. If you use water under pressure, the consumption of water is lesser rather than having a slow open tap on for 15-20 minutes. Defrost without water plan ahead to thaw frozen foods. Hand wash dishes efficiently, scrape dishes and rinse all at one time. Soak pots and pans overnight. Wash only full loads in the dishwasher.

In the outdoors, use a bucket of water to clean your car instead of a hose. Sweep the sidewalks, the driveways and patios instead of hosing. Clean gutters and downspouts manually without using a hose. Cultivate the soil regularly so water can penetrate and develop a good root system. In industries, especially in food processors. Food processing industries typically use water for washing and sanitation, cooling, heating and processing of food products and other functions as well.

Typically the opportunities for water conservation include; reusing water in another process i.e using rinsed water in cooling towers. Modifying processes to consume less water. Recycling water within a specific process where health regulations actually allow it. Modifying cooling towers to recycle water.

In hotels and motels, hospitality industry business; primary hotels and motels use water for a variety of functions including laundry, preparation of food, cooking and eating as well as landscaping. Typically the largest use of water occurs in the guest rooms, therefore, many of the water conservation approaches have been successfully used to ensure that certain customers are regulated to ensure that water consumption can be reduced such as; installation of ultra low flush toilets, low -flow showerheads, faucet aerators; recommended for hotels and motels.

Educating the public, a robust education and outreach programme for water providers, employees, school children as well as adults. A public education programme through workshops, printed material like bill stuffers, brochures, ordinances, etc. Block leader

programmes, beat the peak, displaying conservation strategies, city's website, city hall, etc. School educational programme.

Ground water is completely deteriorating. Ground water withdrawal exceeds recharge watertable in major cities and that is of an increasing concern. Additional water soureces require expensive treatment - desalination. 70% of 5,60,000 wells in the Indus Basin - Sodic water. Public awareness of conservation involves - dissemination of proper information, installing meters, leak detection, meter reading, billing and collection, Fiscal planning and operator training. Like we just discussed, meter needn't be installed in places only where it is going to be charged, it can also be installed as a warning to residents to ensure that if a person uses more than a certain amount of water, they are in a particular dangere zone. Thereby, recommended to reduce consumption.

Large apartment complexes where tankers are bought, if meters are installed, families can be built according to consumption rather than the size of the apartment. For instance, an apartment could have four bedrooms but it can only house three people and the consumption of water could be way higher than a house which has two bedrooms having about 8 people involved. We can monitor this using meter and this meter will help regulate consumption of water, not only on a community level but also on a personal level, we can keep a check on our consumption tendencies. Public education is very critical. We need to prepare printed material regarding water loss. Prepare public service announcements. Arrange lectures and talk in classrooms to educate the children. Arrange for events such as dramas to show the effect of clean water. Share films on saving water.

Water metering is very critical. The lack of meter reduces accountability. You need to impede incentives to conserve water. The customer does not relate to the amount of water being used. It leads to irresponsible behaviour. Whether we are being charged or penalized is secondary but a conscience should be aware of how much water is one consuming. If we have a relatable table as to what is acceptable and not acceptable to families of various sizes, it is easier for people to conserve water. The people and the community as a whole will be more awake to the consequences of loss of water. Fiscal planning and operator training - Budget/ rates need to be finalized to fund maintenance and capital improvements. Operator training to improve skills, Regular water tests and Record keeping that will ensure the water being tested at regular intervals is recorded to ensure and give an idea as to what are the particles within and what are the impurities that are increasing or decreasing. What are the conditions of salt level in the water which is increasing or decreasing which will give us an idea about the condition of ground water, our dependency on water tankers from outside sources and other such factors.

A typical house if you look at it, is a 500 hours development. How do we go about maintaining a cost estimate for water meters? Water meters are about 6k for 500m. Meter chamber is 1000 rs, again with 500 hours. Billing and collection - total capital is being calculated. Then you need to have a plumber on hold, inventory of parts, including all of this, we have about 3,11,000 RS. When you actually look at this, it is a very nominal amount.

Over 15 states have conservation programmes. EPA estimates that 100 million kWh of electricity per year could be saved if one in every 100 American houses were retrofitted with water efficient fixtures. Water sense - if 1 percent of American homes replaced their older, inefficient toilets with WaterSense labeled models, the country would save more than 38 million kWh of electricity - enough to supply more than 43,000 households electricity for one month.

Conservation is a positive programme. Every rupee spent on water efficiency yields multiple benefits to the utility, customers and statewide. Often water conservation is less costly than providing new water supply. We need to constantly update ourselves, learn from other countries like the United states in Europe which have gone through the crux of water conservation and like how we have electricity bills, they are water bills that have to be paid as well. If such a scenario actually emerges, we might think, oh my god its so much of an expense, why do we want to include it? But indirectly we are paying, let it be maintenance via buildings or even if we are living in independent homes, we will end up ordering tankers for 10,000 - 20,000 rupees. We are essentially paying for our water in some form or the other. Buying canned water, instaling air purifies, all of these are expenditures from our end towards water. But if we ensure that our conservation of water through metering is available and possible, its possible to not only conserve water but also keep a check on our consumption. Once we actually attach a monetary value like your water bill is so much, you have to pay so much, people will automatically learn to consume less water. What's happening now is that, people don't have that pinch. When the electricity bill comes, we realize we have to pay for it, let's switch off the air conditioner, the fans and lights when we aren't using but the pinch on water is still not felt because we do not pay for it directly as a monthly bill, if that happens, people will realize that 'yes! I have to reduce my water consumption in some way or the other'. People will actually come up with better options. A simple example, with the drought that happened in Maharashtra recently, they decided that all air conditioner units will give out certain amount of water as from the compressors. All of this water was collected in buckets and this water was used to wash cars in colonies, it was used to water gardens and it was used for flushing facilities as well. Only when face a particular type of situation, we come up with a solution as well.

Rain Water Harvesting

What exactly is rain water harvesting? Rain water harvesting is the process of collecting, conveying and storing water from rainfall in an area for beneficial use. Storage could happen in tanks, reservoirs, underground storage-groundwater with typical hydrological cycle you can see over here, it is a relationship between evaporation and precipitation that again gets collected as groundwater or in lakes or as surface water in rivers, etc.

What is rainwater harvesting? This technology consists of a simple system to collect and store the rainwater. Rainwater capture is primarily from the rooftop, surface runoff and other surfaces. RWF either captures stored rainwater for direct use like irrigation, production, washing, drinking water, etc or is recharged into the local groundwater and this is called artificial recharge. In many cases, RWH cases are used in conjunction with Aquifer storage and recovery or ASR. ASR is the introduction of RWH collected rainwater to the groundwater/aquifer through various structures in excess of what would naturally infiltrate then recovered for use. Typical methodologies used; Roof Rain Water harvesting, Land based rain water harvesting, Watershed based rain water harversting. For urban and industrial environment, roof and land based RWH. Public, Private, Office and Industrial buildings. Pavements, Lawns, Gardens and other such open spaces.

Rain water harvesting is a proven model with just taking Chennai as our model. Chennai has overcome a huge drought phase simply because of harvesting the rainwater we have gotten and now it has become a law as a part of the building authorities, that any construction that is made within the city, let it be private, residential, commercial; any building, rain water must be harvested either through the roof as mentioned or some methodology must be used to encapture that water and store it. Why is rainwater harvesting crucial ? It helps conserve and supplement existing water resources. Available for capture and storage in most global locations. Potentially provide improved quality of water. Supply water at one of the lowest costs possible for a supplemental supply source. Capturing and directing storm water (runoff) and beneficially use it. Commitment as a corporate citizen, showcasing environmental concerns. It has become a Public Mandate in India. It is replenishing local groundwater aquifers where lowering of water tables has actually occurred.

Rain water harvesting, the typical advantages - provides self sufficiency to water supply. Reduces the cost for pumping of groundwater. Provides high quality water, soft and low in minerals. Improves the quality of groundwater through dilution when recharged. Reduces soil erosion and flooding in urban areas. The rooftop rainwater harvesting is less expensive and easy to construct, operate and maintain. In dessert, RWH is the only relief. In Saline or coastal areas and islands, rainwater provides good quality water.