Urban Utilities Planning: Water Supply, Sanitation and Drainage
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Module - 07
Sanitation and Drainage Fundamentals
Lecture - 32
Sanitation Basics Part II

In lecture 32 we will talk about Sanitation Basics, Part II.

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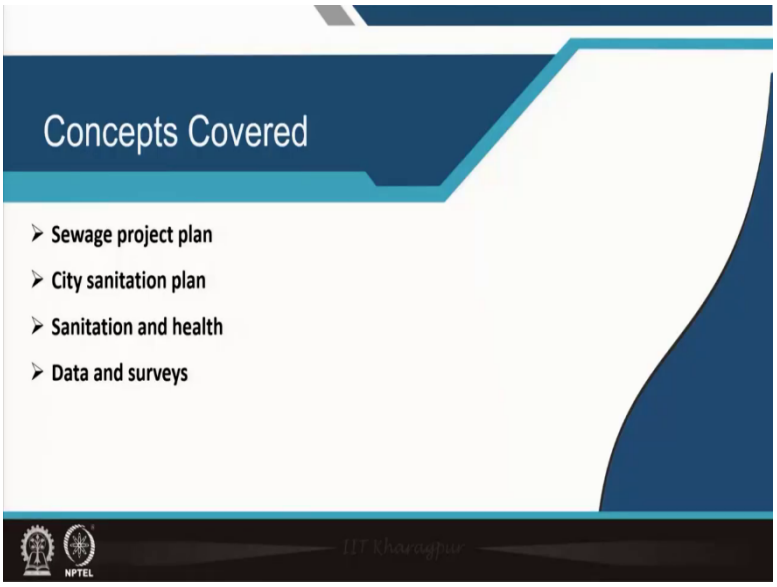

The concepts covered in this particular lecture are sewage project plans, city sanitation plans, sanitation and health, and the different data requirements and surveys.

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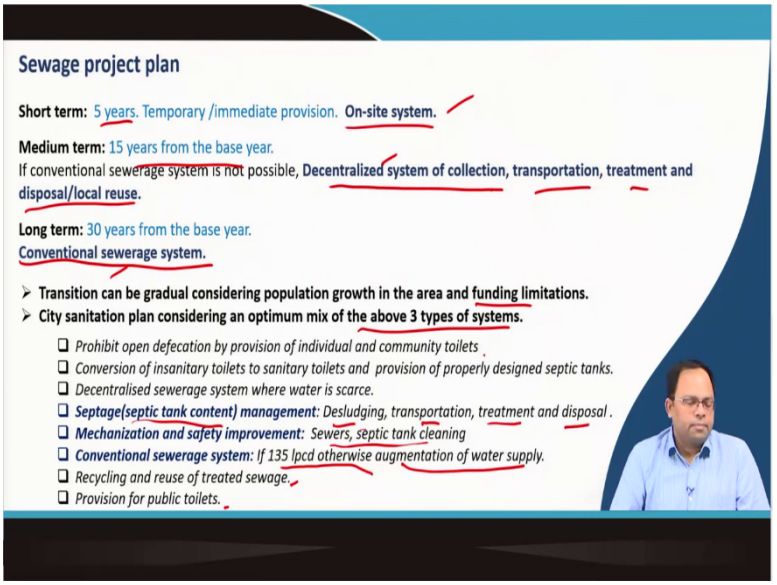

Sewage Project Plan

Any kind of sewage project and its execution can involve different time periods; short periods, medium periods, and long periods. A long time period is preferred for sewerage network design, i.e., around a 30-year period as the timeline. At the end of 30 years from the base year, we should primarily have a conventional sewerage system which is the standard method to deal with sewage. However, this is not always a feasible option because of financial and other reasons.

If a conventional sewerage system is not possible, then a decentralized system of collection transportation and treatment, and disposal or local use is preferred. To design such a system, 15 years is recommended. We can even think of shorter time periods of 5 years when we can provide onsite systems in case of immediate requirements. Onsite systems are when we provide sanitation just for that particular building or may be a group of buildings and we are able to treat or dispose of the waste in a proper manner.

So, an onsite system, decentralized system, and conventional sewerage system are the three types of systems that can be designed.

The city will transition and the population will gradually grow. Consequently, the taxes will become higher. In the absence of funding limitations, at the end of 30 years, we can have a

conventional sewerage system. However, initially, we can opt for onsite systems or decentralized systems based on the requirements. So, a city sanitation plan can have an optimum mix of all three types of systems. Even at the end of 30 years, based on the layout of the city, the density of population, contours of the city, and other factors, we can have a mix of three systems. Everything may not be converted into a conventional sewerage system because sometimes it may not be technically feasible.

Open defecation must be prohibited with the provision of individual and community toilets. There is a need for conversion of insanitary toilets to sanitary toilets and provision of a properly designed septic tank. A decentralized sewerage system is employed where water is scarce as many Indian cities do not have sufficient water. So, it is preferred to have a decentralized sewerage system instead of a conventional sewage system. We should prohibit open defecation by provision of individual and community toilets. So, this is the first point that has to be achieved in an urban area, then conversion of insanitary toilets to sanitary toilets with provision of properly designed septic tank can be taken up.

So, if there are insanitary toilets in an urban area; that means, it's a normal pit toilet. We can make it into a twin pit toilet with a pore flush system which are much more sanitary compared to just a single pit system.

Decentralized sewerage system can be employed where water is scarce and many Indian cities lack water resources. So, it is better to have a decentralized system there instead of a conventional sewage system.

Septage or septic tank content management is one of the biggest issues in suburban and semi-rural areas where there may not be a well-equipped municipality or the urban local body to clean the septic tanks.

This involves desludging or cleaning of septic tank or toilet pit and eventual treatment and disposal of the sludge accumulated in septic tanks. Thus rural bodies like a panchayath has to have the capacity to provide this kind of services. Otherwise, we cannot have septic tanks in rural areas.

Similarly, mechanization and safety improvement is mandatory as per law for sewers and septic tank cleaning. Thus, if a minimum of 135 lpcd water supply is not there, then we have to augment the water supply otherwise, these systems will fail. Recycling and reuse of treated sewage is also made mandatory now along with provision of public toilets.

So, these are the different mandates that a city has to achieve very fast to make our cities adhere to different ODF protocols.

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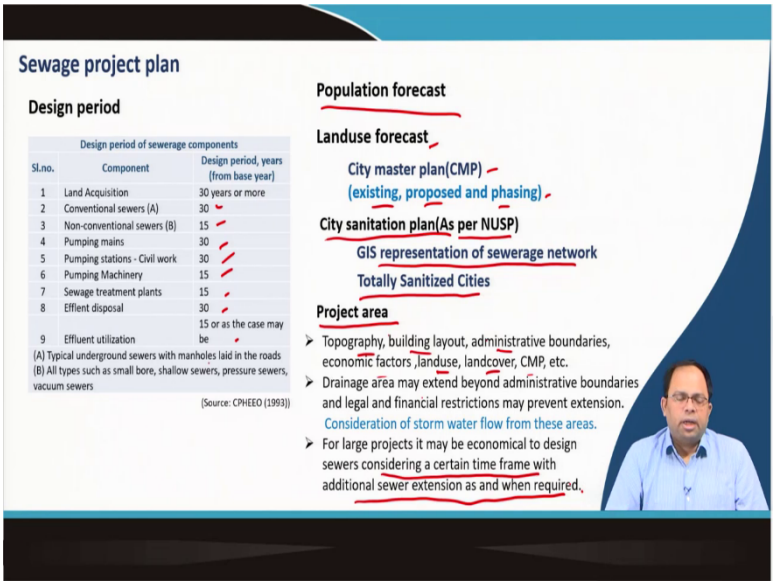

So, similar to water supply projects, sewerage projects need to have a design period. In most cases, the design period is 30 years, particularly for conventional sewers. However, for non-conventional sewers like a decentralized system design period is for 15 years. Similarly, for pumping main it is 30 years, pumping stations 30 years, machinery 15 years etc. Sewage treatment plants have a design period of 15 years because it involves a lot of machinery. The effluent disposal design period is for 30 years.

After choosing the designated design period for the project, we need to estimate the projected population for the same. Then, the land-use forecast is required. This helps in understanding how the expansion of the network would take place. City master plan tells us about the future population forecast, the existing, proposed, and the phasing of the land use for different zones.

For preparing a city sanitation plan, the GIS representation of the entire sewerage network is required. This not only helps in designing or augmenting the existing network but also helps other utility providers and service providers to achieve sanitized cities.

Once that is prepared, there is a need to identify the extent of the project area. In the case of a large area, it has to be broken down into catchments or zones. So, this depends on the topography, the building layouts, administrative boundaries, economic factors, land use, land cover, the city master plan of that area.

A major issue is when the drainage area extends beyond the administrative boundaries. Legal and financial restrictions may prevent extension of our project into these areas. This is an issue we need to be aware of because due to the existing slope the water from the adjoining area may come to the area concerned or vice versa. So, this needs to be considered when we design our system.

For large projects, it may be economical to design sewage considering a certain time frame with additional sewer extensions as and when required. So, it is not feasible to develop the entire network at a stretch. For this purpose, we need to do proper phasing and have extension plans since we cannot lay down everything at once.

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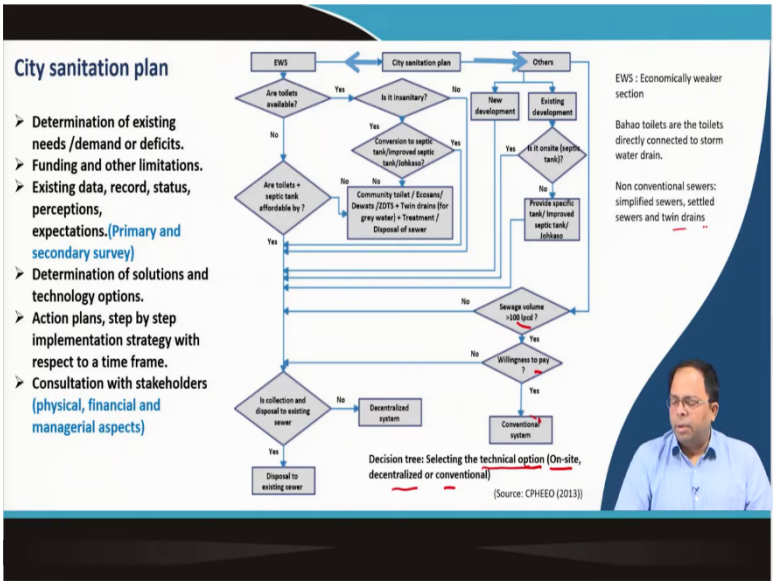

City Sanitation Plan

The first step is the determination of existing needs and demands or deficits. Then, the source of funding for the projects has to be determined. There is also a need to collect a huge amount of data, records and to understand the current status of the existing infrastructure.

The perceptions and expectations of people are very important. It gives us an idea about what people want, how much they want, and how much they are willing to pay for such a service. This can be achieved through primary surveys and secondary data sources.

A huge amount of data is required particularly for sewerage and drainage which is one of the primary reasons why Indian cities have poor drainage and sewerage plans.

There could be multiple solutions in terms of technology and we have to decide which one to choose from and then prepare an action plan with a step-by-step implementation strategy concerning time frame. This involves deciding which zone has to be taken care of first and which treatment unit is provided.

The next step is to consult with all the stakeholders and then propose the plans. Using an example from the CPHEEO manual, a decision tree is used for selecting the technical option of providing an onsite decentralized or conventional system for a particular area. The first decision is to determine the kind of groups that needs to be catered for such as economically weaker sections (EWS) or others. If EWS is chosen, the next step is to check for the availability of toilets. If not, it is checked if the provision of toilets with septic tanks is affordable by them or not. If yes, then we go for collection and disposal to the existing sewer. If not, then we go for a decentralized system.

In the case of toilets being available, we check if those are unsanitary? If yes, then we try to convince for conversion to an improved septic tank or johkasou system. If not due to lack of funds, we can go for community toilets. Similarly, if toilets and septic tanks are not affordable, they can go for community toilets. So, in this way, we can have a decision matrix in which you can create your decision matrix for your area and you can determine what sort of system is suitable. So, for example, for groups other than EWS, we can have a new development or existing development. For existing development, should we opt for an onsite

septic tank? If yes, then we repeat the same steps as mentioned previously. If it is not, then we can improve the septic tank and johkasou. So, once the treatment is done, the collection and disposal are carried out. If the sewage volume is greater than 100 lpcd and they are willing to pay for it, they can directly go to conventional sewers.

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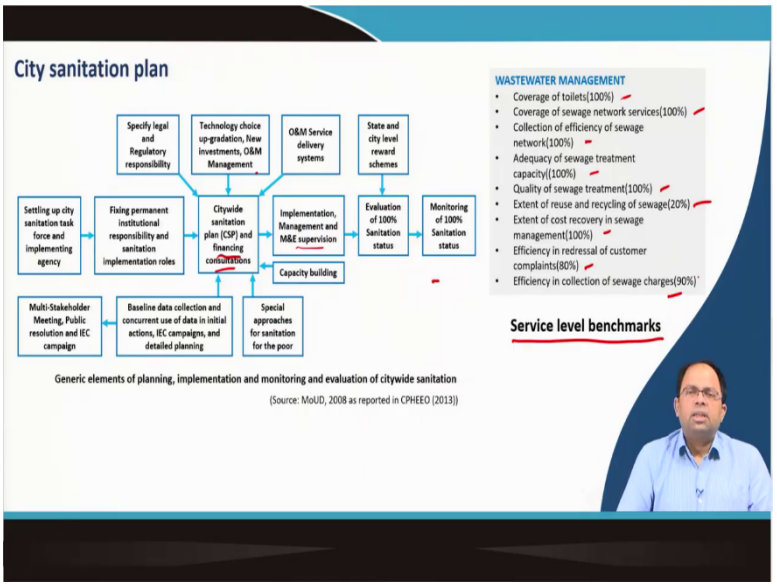

City sanitation plan is not just a technical document, but also a financing document that determines what kind of investment has to be there. It determines the kind of operation maintenance, finance management and procurement required.

First of all, we need to set up a city sanitation task force and implementation agency. The next task is fixing permanent institutional responsibility and sanitation implementation roles. Even within a municipal body or an urban local body, we have to have a permanent institutional responsibility and sanitation implementation role-specific only for sanitation. We have to set up different groups and conduct multi-stakeholder meetings and public resolution and IEC campaigns. Then based on that, we can look into the baseline data collection and concurrent use of data in initial action IEC campaigns and detailed planning. So, we can see baseline data collection and then deliberate on those data that we are collecting and analyze the existing situation and focus on areas that need improvement.

Simultaneously, we have legal and regulatory responsibilities which determine what has to be provided, the kind of technological choices for upgradation, new investment, and operation maintenance management. The different options are to be chosen such as operation and maintenance of service delivery systems such as the kind of delivery needed, either PPP mode or contracts. Special approaches for the poor, capacity building, implementation and management, and its supervision.

Once that is done, we have to evaluate what we can achieve. For this purpose, we have certain rewards at the state level or the city level. Cities that can achieve certain levels may get more funding. So, these are the different elements of city-wide sanitation plans.

Based on the different service level benchmarks, different parameters have to be achieved in wastewater management including coverage of toilet which should be 100 percent such coverage of sewerage network services, the collection efficiency of sewage, adequacy of sewage treatment capacity, quality of sewage treatment, the extent of reuse and recycling (20%), the extent of cost recovery in sewage management, efficiency in the redressal of customer complaints (80%)and efficiency in collection of sewage charges (90%).

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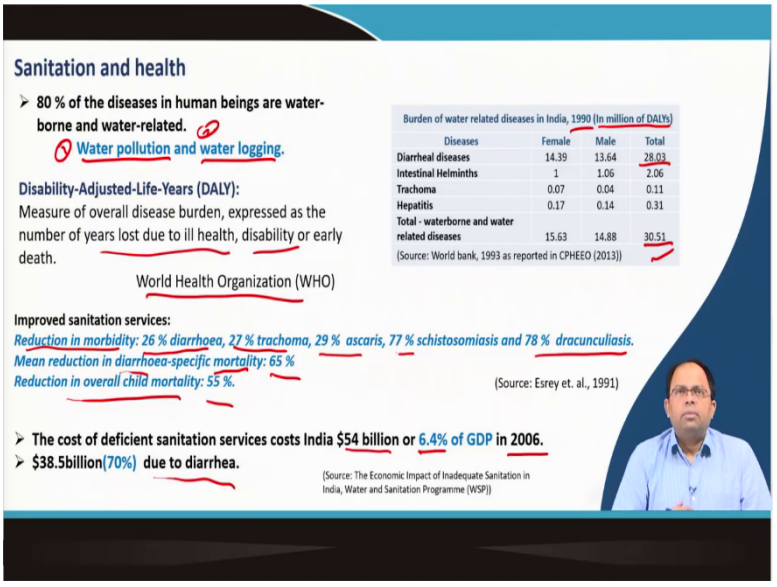

Sanitation and health

A major issue of sanitation and sewage treatment services in an urban area is public health. Sanitation and health are intrinsically linked. Around 80 percent of the diseases in human beings are waterborne and this is primarily because of water pollution and waterlogging. There is a need to prevent both of these issues. WHO uses the term Disability-Adjusted-Life-Years (DALY), which is a measure of overall disease burden, expressed as the number of years lost due to ill health, disability, or early death. This is expressed in the total number of years a person loses in his life. In India, in 1990, there was a study and the value is in millions of DALYs. For the entire urban population in India in 1990, 14.39 million days are lost by females and 13.6 for million days are lost by the male which could have been put to much productive use and generated money. Total waterborne and water-related diseases comes to around 30.51 million DALYs.

We need to understand what would improve sanitation services and how can we reduce mortality and morbidity. Morbidity refers to regular ailments due to diseases and mortality refers to the death. It's very difficult to say what kind of improvement leads to what kind of disease reduction. So, we cannot have a direct correlation. In general terms, based on different studies, morbidity can be reduced by 26% from diarrhea, 27% from trachoma, 29% ascaris, 77% schistosomiasis and 78% dracunculiasis. We can also prevent 65 percent of the deaths resulting from diarrhea and a reduction in overall child mortality would be 55 percent. These are massive figures which can be achieved with the improvement in sanitation services. In terms of the cost estimate, the cost of deficient sanitation services in India amounts to around 54 billion dollars which is 6.4 percent of the GDP in the year 2006. This is the amount of money we lose which if we could have invested in sanitation services.

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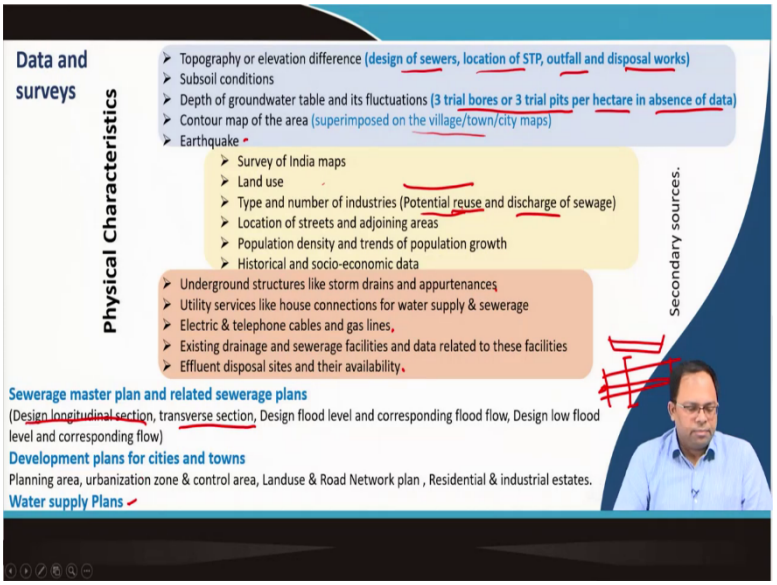

Data and surveys

Different kinds of data collection and surveys have to be carried out to prepare sanitation plans, drainage plans, and stormwater networks. Data is both from secondary sources as well as primary sources. We will require data on topography (elevation difference influences design of sewers), location of STP, outfall, and disposal work. The entire network design is based on topography, subsoil conditions, moisture content, groundwater table, and its fluctuation. If we are designing such systems in an area with no available data, then we have to conduct actual field surveys. For that, we need to do three trial bores or three trial pits per hectare in absence of data. Other details required are contour map superimposed on the village, town, or city maps. Earthquake information, the survey of India maps, land use maps, type and number of industries which determines potential reuse and discharge of sewage are also required. Location of streets and adjoining areas detail, street networks maps, population density, and trends of population growth, historical and socio-economic data are also required. Detailed data on the existing infrastructure such as underground structures like storm drains and other sewer appurtenances are needed. Location of utility services like water supply and sewerage, electric and telephone cables and gas line needs to be known so we don't harm them while laying down new lines. Existing drainage and sewerage facilities and data related to these facilities, effluent disposal sites, and their availability are some of the

general data that we require. If there is a sewerage master plan and related sewerage plans for a particular urban area, we use that as our secondary source. This will include longitudinal and transverse sections of different channels or streams, both natural and artificial. For certain segments, we take longitudinal sections as well. Another important source of data is the development plans for cities and towns which gives us data on urbanization zone, control area, land use, and road network, and all the different information on residential and industrial estates and water supply plans for a particular city.

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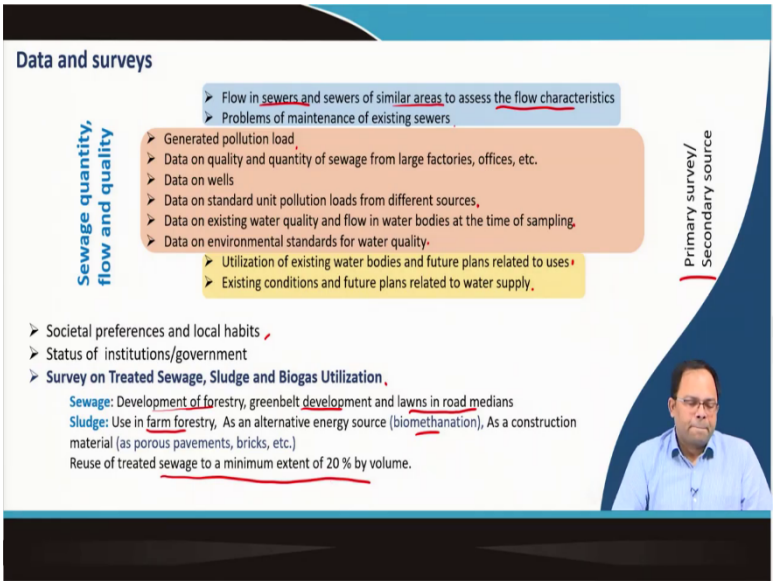

Sewage quantity, flow, and quality of that particular urban area are obtained from secondary sources as well. It is sometimes required to measure the flows in sewers of similar areas to assess the flow characteristics problems like daily fluctuations, weekly fluctuations, and peak demands.The nature of the sewage, problems of maintenance of existing sewers is required to be surveyed to identify the choke points or to understand where people dispose of garbage. Total pollution load, sewage generated, the BOD is also required.Data on quality and quantity of sewage from large factories, data on wells, standard unit pollution loads from different sources, existing water quality of flowing water bodies at the time of sampling, environmental standards for water quality, utilization of existing water bodies in plans and existing condition and plans related to the water supply are also required.

So, we need to understand how the city is planning to augment its water supply and then we have to relate the sanitation plan with this as well. In addition to this, we need to understand the societal preferences and local habits through surveys and then the status of institutions and governments because they are the ones who are going to implement these particular projects and policies. Survey on treated sewage sludge and biogas utilization is also required to understand if there is potential for reuse. So, sewage could be used in the development of forestry, greenbelts, lawns, and road medians.

So, we need to find uses for treated sewage. Sludge could be directly used in farm or forestry or as an alternative energy source in bio methanation and as a construction material. Then, it becomes economical to a certain extent or we can recover some of the charges. So, reuse of treated sewage to a minimum extent of 20 percent by volume is recommended.

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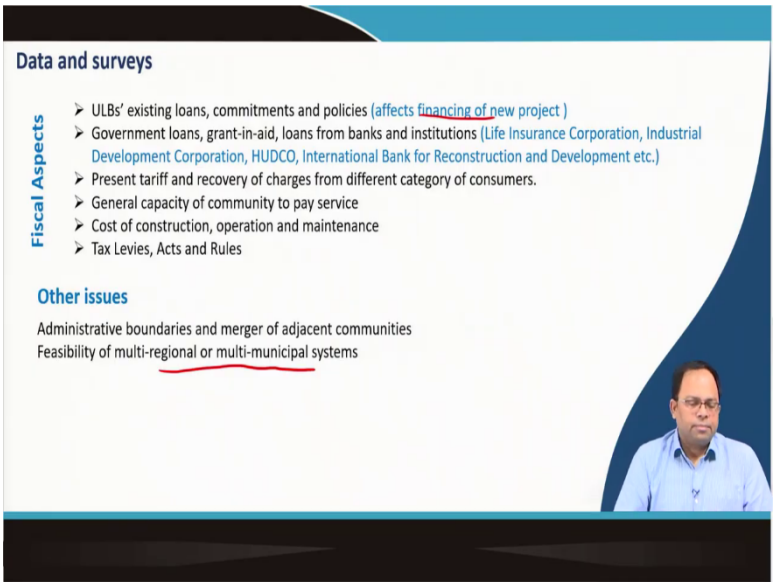

In addition, we need to understand the other aspects particularly related to the ULB because it is the ULB that is going to implement these kinds of infrastructure projects. The existing loans, commitment, and policies of the ULB needs to be looked into and how it will affect the financing of new projects such as existing government grant in aid, loans from banks and institutions like LIC's, industrial development corporation, HUDCO and international bank for reconstruction and development.

Different banks give loans and long-term loans at smaller interest rates for this kind of project. Thus, present tariff and recovery of charges from a different category of consumers, general capacity of the community to pay for this kind of services if the community is not able to pay also needs to be assessed. Then we also need to consider cost of construction, operation and maintenance, taxes, levies, ACTs and rules.

In addition, there are other issues such as administrative boundaries. Merger of adjacent communities sometimes help in designing the networks and increases the feasibility of multi-regional or multi-municipal system which may result in more efficient services.

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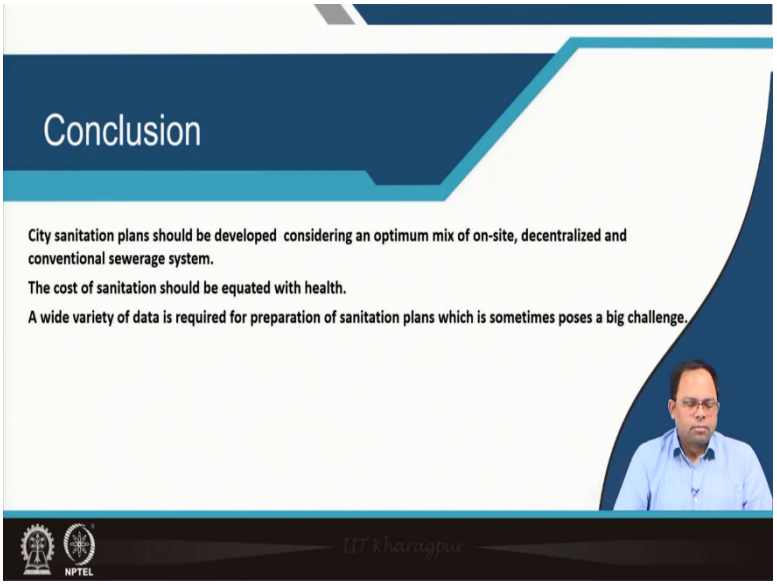

Conclusion

So, to conclude, a city sanitation plan should be developed considering an optimum mix of on-site, decentralized, and conventional sewerage systems. The cost of sanitation should be equated with health, only then can we justify the cost of the infrastructure. A wide variety of data is required for the preparation of a sanitation plan which sometimes poses a big challenge, particularly in the Indian context.

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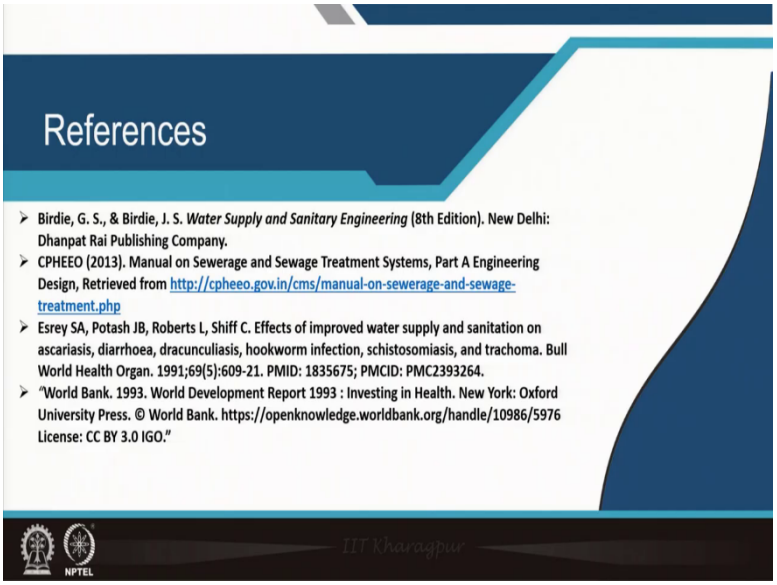

So, these are some of the references you can study.

Thank you.