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Modern Ways of Implementing Renewable and Sustainable Technology and Smart Waste Management in Developing a Smart City

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Abstract— *Across the globe, the movement of population from rural to urban areas is increasing steadily. In terms of urbanization India has been viewed as a by-product of failed regional planning. Now with the announcement of 100 smart cities in the budget by the government, India is also on the way to fast development and planned urbanization. In a smart city, economic development and activities are sustainable and consequently incremental due to the fact that it is being based on success-oriented market drivers such as supply and demand. They benefit everybody including citizens, government and also improve exposure to tourism. But, there are many obstacles which are to be taken under consideration during this process. It is quite clear that planning a smart city and making it come alive on the ground from paper is a big challenge when it comes to engineering. Keeping in mind the environment factor, there should be technologies that are renewable and sustainable. In this paper there is information about the fundamental sectors of economy that are to be considered while making a smart city, their problems or loopholes and the solution to them by modern technologies and planning which are efficient, eco-friendly and are already being used in some parts of the world with effective results. These technologies when used in a proper manner can come out as a boon for both the social and economic sector. Most importantly the environmental degradation is very much checked when the techniques that have been suggested are applied effectively.*

1. INTRODUCTION

The concept of smart cities varies from city to city and country to country. There isn't any fixed or universal definition of a smart city. Even the word "smart city" is a fresher word in context to what it was called earlier as "sustainable city" or "digital city" during 1990s and early 2000s. It mainly depends on the city residents. Their intension to change the social as well as economic infrastructure. Twentieth century prototypes of urbanization were applied without consideration of future outcomes. But in the twenty-first century the planning should be done so that there is growth in prosperity of city and social collaborations. This is because the future cities will serve as drivers for national & regional economics.

2. METHOD AND APPROACH

In this paper we have considered various primary sectors of an economy and presented the different methods that can be used to enhance the stability of them. These methods are being used in several regions around the globe and have proved themselves. Such techniques and measures when encompassed can actually make the planning of a city and its various aspects worthy calling "smart". The sectors we have highlighted are:

- Water resources and management
- Road Technology and Smart Street Lighting
- Disaster Management
- Latest Technologies

In the coming era as the value of time would be unspecified and so as the speed of persons. The persons who used to walk on street would be on latest technology to utilize time in best possible way. And hence the idea of smart city arises keeping in mind the comfort and convenience of people. All the latest plus safe and sound facilities are used in it. The use of renewable sources and waste is also practiced.

3. INTEGRATED RAINWATER HARVESTING SYSTEM

The retention and storage of rainwater is simply termed as "Rainwater Harvesting". In the preceding decade the process of rainwater harvesting have proved its usefulness all around the world. Rainwater harvesting is widely practiced for irrigational as well as domestic purposes. One vital application is the groundwater recharging systems. The rainwater harvesting is categorized into two parts:

3.1. Traditional Methods

This type of rainwater harvesting is done usually in rural areas. Surface storage bodies like ponds, irrigational tanks, temple tanks, etc. are used under this category.

3.1.2.Modern Methods

The modern methods of harvesting are planned more scientifically and are more efficient as compared to traditional methods. The modern approach involves various techniques like:

- Artificial Recharging
- Groundwater Recharging
- Groundwater Dams

Though all these techniques have been in use continuously but till now no such system have been developed which can manage the rainwater from several houses of a locality and use that water for further necessary applications. In other words a smart integrated system of rainwater harvesting isn't yet been developed. Such systems are useful because they help the water collected to be used for purposes like gardening, public drinking water points, etc., even after being accommodated for domestic use.

The concept of such a technique comes from the water management system of the Indian President's residential place, "The Rashtrapati Bhawan".

3.2. An overview of rashtrapati bhawan water management system

The Rashtrapati Bhawan is about 133 hectares in span and holds up the staff strength of 7000 people. On an average count about 3000 visitors attend the Presidential Estate daily. Clearly the consumption of water in the premises is not just big but its "huge". All this load is managed by different measures such as well recharging, rainwater storage tanks, etc. But the system which is most considerable is "Johad".

Johad is a crescent shaped architecture made besides a sloping catchment in which the surface runoff is captured and stored in the groundwater storage with the help of several pipelines and drainage.

3.3. Concept of johad system to build integrated water harvesting model

The model of Rashtrapati Bhawan water management system can be very useful because of the integrated system which one one side hold larger amount of water stored and on other side benefit both the individual and public. In simple words it can be explained as a system of several connecting waterlines or pipelines which come from the rooftops of houses and other sources and store it into a set of small storage tanks which are placed underground. Firstly this water is sent to the respective houses from which they come for washing, bathing, etc. purposes. After this now the water again starts filling the storage tank. When the water starts filling to the extreme level or the flush point it is flushed into a bigger tank from where it is sent to treatment plant for further use. This can be used for various household purposes like washing, bathing, cooking, gardening, etc. or can act as supplies for public toilet, drinking water points and much more.

4. FUTURE ROADS

Due to flexibility of roads being more than other several transport options and the affordability of a larger section of society to the road transport. It is considered the backbone of transport system of a country. The invention and rapid development of automobiles have made the expansion and improvement of roads come alive to a wider extent. Asphalt have been used as a traditional material when it comes to engineering and building of a road. As we know there is always a scope of improvement in everything then how comes the usage of asphalt be an exception to it. The improvement of roads is possible when we use some modified materials while laying down the roads. Two such roads which are being used in various parts of the world and can be a deserving part of a smart city are:

- Plastic Roads
- Rubber Roads

4.1. Plastic roads

Plastic roads refer to adding up of waste plastic with asphalt or more precisely with bitumen to prepare roads. The benefit of doing so lies itself within the side effects of asphalt and stability of traditional roads. Before going to the concept of plastic roads some facts about the asphalt should be raised forward. Asphalt is to be blamed for emitting nearly 1.6 million tones of carbon dioxide (CO_2) in the atmosphere every year which is only 2% of total roadways emissions. On the other hand, plastic road doesn't emits such a huge amount of CO_2 as well as they are unaffected by corrosion. Also they can last over 50 years and survive extreme conditions from -40 degree Celsius to 80 degree Celsius. The plastic road can also be made in such a way that there is a gap between the base and the uppermost layer. This type of system is hold by several supports. As a result a small hollow chamber can be made within a road which can be used for pipelining purposes easily. The other method of including plastic is the mixing of it with bitumen. The following procedure takes place while preparing plastic roads by plastic-bitumen mixture:

- After removing PVC waste from collected plastic waste the whole collected waste is shredded
- The aggregate is heated upto 165^{o}C and transferred to mixing chamber where the bitumen which is also heated upto 160^{o}C is sent.
- The shredded plastic is mixed with the aggregate and it gets coated on the mixture. This plastic coated mixture is mixed with bitumen and laid at temperature between 110^{o}C to 120^{o}C. The roller capacity is 8 tones.

4.2. Rubber roads

Rubberized asphalt concrete (RAC) or rubberized asphalt is a pavement material made by adding with bitumen rubber as crumb rubber from tires. Asphalt rubber can be the most reliable material for making roads especially on highways.

This is because the roads made of rubberized asphalt require less maintenance due to anti-ageing property invoked because of the anti-oxidants of tires used. Also they do not undergo reflective cracking due to the fact that such roads are shock absorbent.. Rubberized asphalt when used in Stress Absorbing Membranes (SAM) or Stress Absorbing Membrane Interlayers (SAMI) reduces the occurrence of reflective cracking to high extent because of its elastic properties. The SAM or SAMI can effectively stretch and move with the underlying pavements rather than cracking from the stresses. Such roads lesser the chances of skidding vehicles as a result reducind road accidents. The noise level of highway traffic tends to decrease to about 5 decibels using rubber roads. Over millions of tires and rubber commodities are unused not only across a city but also throughout the country. All such unused material can be used to make rubberized asphalt. About 500-2000 scrap tires are needed to make a one mile road. Though such large amount of tires may be unavailable at certain times and also these roads can't be made on every highway. Still such roads can be made within a city or a locality or colony where considerable amount of population lives so as to help the citizens in travelling safely that even with lesser noise pollution.

5. DISASTER MANAGEMENT

Disaster management one of the most challenging and most revolting topic in development of any economy as well as in any development. Natural disasters bring lots of damage to the society some of the precautionary cures are:

5.1. From earthquake

Sensitive Soniographs should be used in smart cities to alert the citizens as fast as possible. A active voice message should be send immediately to the citizens as fast as possible. Advance first-aid should be provided after disaster. These were the precautions at the time of disaster. But before the disaster the precautionary measures are The design of the building in earthquake prone area should be of H, L, W, X and Z. The constructers should keep in mind the advantages of constructing these types of building may cure from highly fatal earthquake shocks.

5.2. From floods

Flood another challenging disaster. Precautionary measures before flood are the constructing design of a building should be elevated above the surface and the pillars deep inside the surface for the stability of house. This is done so that the force of water is suffered by the pillars only and not by the whole house. As it is well said "A DROWIND MAN CATCHES A STRAW" similarly a life-Jacket is a straw for victims of flood. After the calamity first-aid should be provided as soon as possible.

5.3. For fire-safety

At the time of fire High intensity alarms for alertness, highly - Sensitivity water sprinklers for emergency, Fire extinguishers in each corridor of the floor and for each house, Auto-opening of windows and gates at the time of fire. Before fire precautionary measures are at least one fire-station across ten societies. Use of harvested rain water and solar water heaters for getting water and heating it for extinguishing fire.

6. DIFFERENT TECHNOLOGIES IN THE SMART CITY

Since to develop a city to smart city use of latest technology is necessary so here are some of the latest tech. used in the development of a smart city are :

6.1. Radar sensors

For auto functioning of multiplex entrances and exits. It works on the principle of weight sensor. As the persons compresses its weight on or nearby sensor the entrance or exit gate opens automatically.

6.2. Entry in multiplexes through retina or thumb identification

This technology is used when the person tries to enter a multiplex he/she is asked to either enter his/her thumb impression or asked to show his retina. Through this proper identification is done of the person who will lead to a brief knowledge of the entering and exiting passengers. This technology is introduced to reduce criminal and terror attacks.

6.3. Use of escalators

Escalated walkways as footpaths are used to increase human efficiency and reduce time loss. This can even reduce accidents as the persons cannot break any walking rule through it. This technology is also useful for the people who are physically challenged.

6.4. Integrated road circuits

Integrated road circuits are used for managing traffic. It is a system in which 4 to 8 roads are connected through a circular diverge. This is used mostly on roads of heavy traffic. This has also lead to reduction in accidents on the heavy traffic roads.

6.5. Drainage automation

Drainage automation is a very useful tech. as at the time of heavy rainfall this can protect the roads from getting filled with water. This can also reduce traffic and accidents caused during heavy rainfall as when roads are filled with water many slipping and crashing cases are heard. The level of water would be lifted upto certain inches and then drains would be automatically opened. This would lead to cleaning of drainage through forced water supply.

6.6. Vehicles running organic gases

Introduction of organic gas vehicles can lead to reduction in pollution as well as can strength the economy. Organic gases are cheap and easily available and have high efficiency. The

efficiency of any organic gas can easily be moulded, so the use of organic gas in vehicles is really useful. Example: ethane, methane. Use of organic gases like ethane and methane as they cheap, efficient and are low on pollution. This can lead to a strong economy as much of the national income is lost in the exchange of natural oil and gas.

6.7. Development of solar devices

Solar heaters, fans, lights and solar panels are the need of today as they lead to no pollution and are highly efficient. They are one time investment. Initially they may be found expensive but for long run they are considered cheap.

6.8. Temperature detector for safety measures

When there is a change in temperature it is gradual i.e. the temperature rise is 2-5 degree centigrade in a day. But when there is sudden increase or decrease in temperature this implies a disaster or any problem surrounding that place. At this time the technology of temperature detector is used. When there is a sudden increase in temperature this indicates that there is fire in that area and prevention could be quick. Similarly, when there is sudden decrease in temperature this indicates that the flood is arriving or it is about to come and in this case preventions can be taken as soon as possible.

7. SLUDGE TREATMENT

Bulky agents and sludge are first mixed. Then, they are separated into two columns. One of the columns is forced aeration and the other is turning. Firstly, in forced aeration the mixing element is dried i.e the water is solid is separated and in tuning maximum liquid part is stored. Then from forced aeration and turning liquids are mixed together in curing tank and there they are treated by recovery agents like silica gel, chlorine and calcium hydroxide. They are treated under UV-Radiation and then stored for further use.

8. CONCLUSION

The concept smart cities is not without challenges especially in India. For example, the success if such cities depends highly on their residents, businessmen, politicians and rate of possible development in that area. There are many ways to improve the daily life of citizens as a high percent of total energy used in the hands of users. It depends on them how they adapt themselves to the change and their habitat and also time factor is a major issue because making such cities in reality can take 20-30 years. The latest technologies used are for the sake of development and comfort of the coming generation. This may lead to increase in efficiency and skilled human resources. Not only this, this may also lead to the improvement in the economy as well as life style. The BPL(Below poverty Line) could be increased with a significant multiplier. The significant development in technologies will also lead to increased rate of employment. The basic idea of smart city arrived from our present prime minister Shri. Narendra Modi.

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