



Development of Infrastructural Facilities and their Impact on Urban Environment of Patna

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Abstract : 'Infrastructure' is an essential element in the process of urbanization as it satisfies the basic needs of the city dwellers. The recent spurt of infrastructural development is no doubt changing the landscape of Patna and heading towards making Patna known as a modern city. Construction of large number of over bridges, roads, new sewerage lines, malls, railway station etc. are changing the horizon of Patna. All this development, is changing the life style of the city dwellers. But the process of change is concurrent with the pain associated with it. The cutting of large number of trees, uses

and misuse of natural resources, pollution, and sedimentation of river Ganga etc. are degrading the environment of Patna. Construction of large number of concrete roads and buildings with depleting forest resources are generating the effect of "Heat Island" thus, the residents are experiencing a change in the seasonal rhythm of the city with exorbitant hot summer, freezing winter and either deficit or excessive rain flooding the city. Further, poor maintenance of infrastructure leads to contamination of water and soil resources which results in health hazard. Thus infrastructural facilities which are inevitable in a modern city are altering the city environment. In the backdrop of the above mentioned scenario, an attempt has been made to study the impact of infrastructural facilities in the present study in Patna MC. The study is mostly based on primary survey. Questionnaire, informal interviews and data collected from concerned public departments were analysed. At the end, government and private initiatives towards the problems were examined and few suggestions have been made to increase the positive impacts and reduce the negative ones of this development

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Introduction:

Infrastructure is the basic systems and services that are necessary for a country or organization to run smoothly like buildings, transport and water and power supplies. (The Concise Oxford Dictionary 607). Infrastructure is a crucial aspect of sustainable development because of its inextricable ties with areas of primary concern-human health, environmental system, air and water quality and economic vitality. The infrastructure of a system determines how people can satisfy basic needs (food, shelter, transportation etc.) that in turn affect the material and energy they consume in providing for these needs. Infrastructure can meet the needs of the citizen either in sustainable or unsustainable manner.

Infrastructure is at the very heart of economic and social development. The coming decades are likely to see an accentuation of two facets of infrastructure. On the one hand, they will prove a vital tool in resolving some of the major challenges faced by societies—supporting economic growth, meeting basic needs, lifting millions of people out of poverty, facilitating mobility and social interaction. On the other, environmental pressures in the form of changing climatic conditions, congestion and so on are likely to increase, turning the spotlight firmly on the inherent tensions between the imperative for further infrastructure development and the quest for sustainability.

Objectives of the Study :

The objectives were devised i) to study the recent infrastructural development of Patna, ii) to evaluate the impact of infrastructural development on natural vegetation of Patna, iii) to investigate the impact of infrastructure on changing seasonal rhythm of Patna and iv) to examine the impact of infrastructural development on air, water and soil resources of Patna.

Study Area:

The present project has been carried on in Patna Municipal Corporation Area. Patna, situated on the cross road of 25° 37' N and 82° 12' E is the capital city of the State of Bihar. It is one of the most ancient cities in India. It is a typical linear city located on the right bank of Patna (Sarkar & Chowdhury, 2011). The total span of Patna Municipal Corporation area is around 101sq. km with a population size of 1,683,200 (Census 2011). It has been further divided into three zones- West, Central and East Patna respectively to study the spatial variation if any within the limit of the city. (Fig 1)

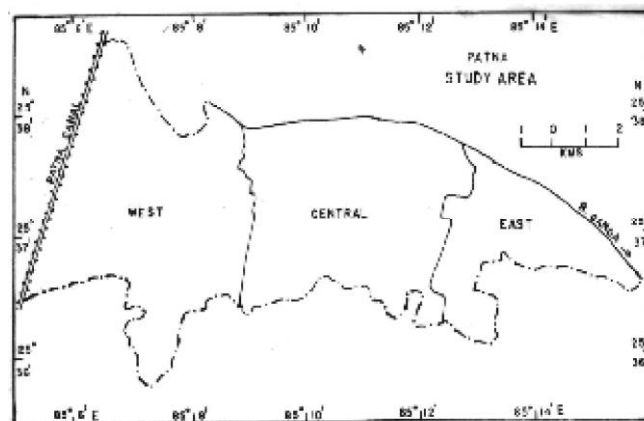


Fig. 1

Database and Methodology:

For the present study, a sample size of 100 people was selected by applying stratified random sample method from three zones (Western, central and Eastern) of Patna MC Area. Altogether 34 people were selected from Western Patna, 33 from Central Patna and 33 from Eastern Patna for the survey purpose. The mean monthly temperature and rainfall data as well as the extreme low and high temperature was obtained from meteorological department of Patna. The SPM level in the air and pollutants such as SO₂ and NO_x was obtained from Bihar State Pollution Control Board. Data regarding the growth of population in

Patna M.C (1901-2011) was obtained from census of India, Bihar, 2011. Average Per Capita Income in various Indian Cities was obtained from census of India, 2007. After collection of data, they have been tabulated and statistical treatments have been given to them. Further, necessary diagrams have been drawn. To supplement the study, the published data and report regarding infrastructural development of Patna MC have been consulted. The study concluded with some suggestive measures to avoid further deterioration of natural and social environment of Patna MC.

Analysis:

In recent years with development of infrastructure, urban environment (both natural and social) of the country is changing at a rapid rate. The capital of Bihar, Patna which is the 5th fastest growing city in India is not an exception. Infrastructural development has changed the horizon of the city and lifestyle of its residents. Rapid and unplanned infrastructural growth and its poor maintenance create pressure on natural environment in the form of changing climate, pollution, congestion, water table depletion etc. Construction of large number of over-bridges, roads, new sewerage lines, malls, recreational sites etc. are transforming the environmental condition of Patna.

In next few paragraphs, a comprehensive study will be done on positive and negative impact of infrastructural development in Patna MC. as viewed by the sample population of the city.

Demographic Composition:

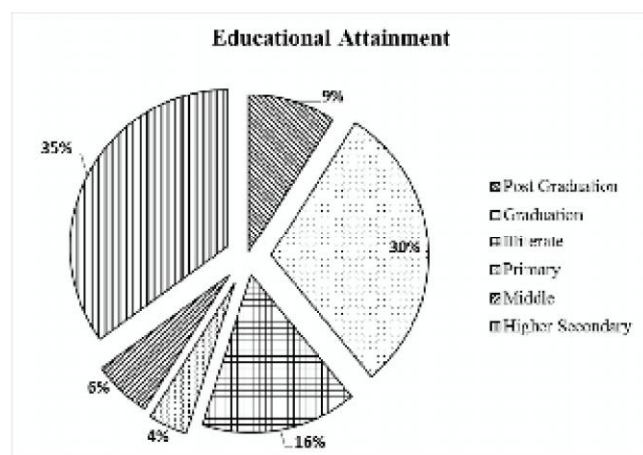
The demographic characteristics of sample population are of great relevance to the study . Demographic composition of sample population has been presented in the table1.

Table – 1 : Demographic Composition of the sample population*

Sex Composition		Age Composition				Marital Status			Economic Status		
Male	Female	20-35	36-50	51-65	65+	Married	Unmarried	Others	Below 15000	15000-25000	Above 25000
47	53	48	33	17	2	71	25	4	28	32	40

* Based on sample survey

It is clear from the above table that 53% of sample population is female and 47% is male. Majority of them are of 20-35 years of age. 71% of surveyed population is married, 4% of them are either widow or widower. Most of them belong to the high income group i.e. 40% and 32% & 28% are from the middle group and the low income group respectively. Hinduism outnumbered other religions. Most of sample population live in nuclear family. According to the data of survey, 84% of sample population is literate. Educational attainment of sample population is clear from fig 2.



* Based on sample survey

Fig: 2

Infrastructural Development :

Housing: The living condition of people is taken as an indicator of development. 76% of the houses surveyed were pucca houses. Large number of pucca houses is the economic indicator which denotes that maximum urban dwellers can

afford these houses. The present condition of housing infrastructure in Patna MC is not satisfactory.

Water supply: In many areas of the city, it is found that water distribution system is quite old. The leaking pipelines are thus adding huge amount to non-revenue water. 53% household use boring for obtaining drinking water while 35% use municipal water pipelines for potable water. Few obtain water from tube well that is in Central and Eastern Patna. Out of 100 household in Patna MC, 31% people categorized the quality of water obtained by them as average and 8% took it as dirty.

Electricity: 88% of the responses on the question of availability of electricity were found affirmative. Only 12% of sample populations were deprived of electricity supply and they belong to Eastern and Central Patna. Power failure is quite common in the city.

Sewerage and Sanitation: The sewerage system of the locality needs tremendous change to cope up with the present scenario. 53% of sample population had covered nala in their locality whereas 7% households told that there was no nala in the locality and the waste discharge takes place in open lowlands. According to the survey data, 65% households throw their domestic garbage on the roadside and only 14% households dispose their garbage in the dustbin. According to 63% household of sample population, the sanitation of their locality was satisfactory. 50% of the household of sample survey considered the sewerage system of the locality as average whereas the figure declined for good and choked categories of sewerage system to 20% and 30% respectively.

Roads and Transport: The maintenance of roads in Patna M.C is not apt. More than half of the roads are improper (53%). The ratio of improper

and proper roads are in equal ratio in West Patna. The maintenance of road is worst in east Patna. Most of the roads in Patna M.C are in average category, few are in good while a number of roads are in bad condition. The garbage from the dilapidated underground drainage system, instead of sucking trash in, spewed even more dirt on the roads making life extremely difficult for the pedestrians in many areas such as Kankarbagh, Bari Path, Sabzi Bagh, Bhanwar Pokhar, Lohanipur, and Dariyapur.

Airport and Railway: Traffic at Patna airport has crossed the one million-mark and it is growing at 30 per cent per annum. The construction of Pataliputra station on Bailey Road near Rukunpura, which was to come into existence last year, will be delayed further due to non-completion of work. Work on this new station is still going on at an estimated cost of Rs 1.5 crore. This project is likely to be completed along with the Ganga rail-cum-road bridge between Digha and Sonapur by the end of 2014-2015 fiscal year.

Telecommunication and Internet: According to the data based on sample survey a total of 88% of schools in Patna M.C. use computers. This percentage is very high in western Patna where more than 97% of respondents said that schools use computers. . It shows the modernization of schools in recent years in Patna MC and the growth of Telecommunication and Internet facility in educational system of Patna MC. Telecommunication and internet facility is growing very rapidly in Patna MC and it is expected to register more growth in the coming years.

Health centres: The respondents of Patna MC seemed quite happy with the level of medical facility being provided to them as 52% of the respondents have their nearest health centres within 1 km, 91% confirmed the accessibility to the medicines, 88% to the Private Nursing Home, 91% to the Doctor and 81% to Emergency service.

Social infrastructure: Social infrastructure of Patna under the present Government is changing at a very fast rate. The establishment of IIT,BIT,AIIMS etc. indicates the rising trend in educational infrastructure. Several numbers of branches of different banks operating in Patna and people are satisfied with the services provided by them.

The infrastructural development in Patna MC is in progress but the quality and quantity of progress is not satisfactory.

Modern Patna and Changing Lifestyle:

It is the infrastructural development which has made Patna as the 2nd most important city in Eastern India. About 53% of people are satisfied by the infrastructural change in Patna MC. However about 29% of people are not satisfied with the rate of infrastructural development.

However, the infrastructural development in Patna have provided the city dwellers all those facilities which they lacked a few years back. All these facilities are transforming the life style of the people in Patna. The modernization of Patna is in process. The recent spurt of infrastructural development is changing the landscape of Patna and heading towards making Patna known as a modern city. The megatrend of consumerism is revamping Patna’s economic structure, besides fuelling business growth in the city. 42% of people are satisfied with the city life in Patna M.C while 34%are partially satisfied and about 23% people are not satisfied with the city life in Patna. People have easy access to malls, parks etc. which they frequently visit. 57% people are visiting restaurants while 43% people of Patna M.C. don’t go to restaurants for outing in Patna MC. Areal variation is clear from the following table.(Table 2) The change is prominent in the Western Patna since the progress of the region is faster than in others.

Table: 2
Visit to Malls and Restaurants by Patnaites*

Regions	Weekend	Monthly	Occasionally	Don't Go
Western Patna	22%	20%	41%	17%
Central Patna	15%	26%	35%	24%
Eastern Patna	14%	26%	30%	30%

*Based on sample population

Infrastructure and Environment: The growth of infrastructure in Patna has economic gains but it also is at environmental costs. Rapid and persistent population growth is one of the major driving forces acting on environmental health. The cutting of large number of trees, uses and misuse of natural resources, pollution, and sedimentation of river Ganga etc. are degrading the environment of Patna. Status of nearby greenbelt in Patna M.C. is given in the following table. 59% of them agreed that the green belt in Patna M.C. has declined as a result of development of infrastructure in Patna while for 29% it is almost the same.

Table: 3
Status of Nearby Greenbelt in Patna MC*

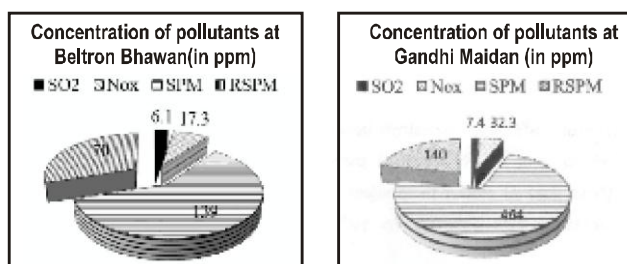
Region	Declined		Increased		Same		Total
Western Patna	20	59%	7	21%	7	20%	34
Central Patna	22	67%	2	6%	9	27%	33
Eastern Patna	17	51%	3	9%	13	40%	33
Patna MC	59%		12%		29%		100

* Based on Sample Survey

In the sample population in Patna MC, 43% of total complained about the depletion of groundwater table in the region. 34% of them depended on the Municipal Corporation for water supply and faces irregularity in it; mostly in the summer months.

The quality of air has deteriorated due to the pressure on the environment. The level of SO₂ pollutant in air has reduced to its half from 12.9 ppm in 2001-02 to 6.8 ppm in 2002-03. The annual mean of concentration of NO_x does not follow a specific pattern of increase or decrease. It was as

high as 62.4 ppm in the year 2002-03 and as low as 24.8 ppm in the year 2011-12. Similar conditions exist in case of annual mean of SPM which ranges from 213 ppm in 2004-05 to 55 ppm in 2010-2011.



*Based on Bihar State Pollution Control Board, Patna, 2011

Fig: 3

The impact of greenery on the air quality of a place was well understood by observing the level of SO₂, NO_x, SPM and RSPM which were relatively lower at sampling point of Beltron Bhawan than at Gandhi Maidan. Beltron Bhawan is located in Shastrinagar which is opposite of Sanjay Gandhi Botanical Garden while Gandhi Maidan is the one of the most busy and congested centres in Patna having least greenery in the surrounding. The level of RSPM at Beltron Bhawan is just half of that present at Gandhi Maidan. 'Bailey Road shows less of air pollution than Gandhi Maidan. There is perceptible decrease in the air quality where the air pollution is increasing every year' (Sahay, 2005). (Fig 3). However, 61% of the sample population didn't find the use of air mask necessary while going out but when they were asked whether they feel suffocation/breathing problem during traffic congestion or when they are out, 90% of the respondents gave positive response. This shows that the use of air mask is needed but people found it troublesome to use.

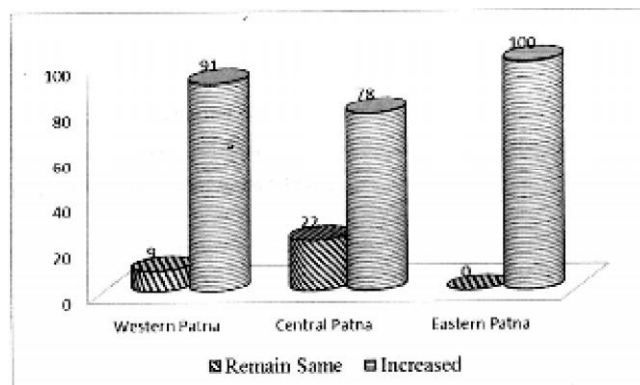
65% of the total respondents in Patna MC throw garbage on the roadside and only 21% household dispose their waste in the dustbin which is collected by sweepers. Lack of civic sense, improper solid waste management, infrastructure

and failure of government/ municipal policy leads to the severity of solid resource pollution in Patna. The surface water is being polluted due to the atmospheric deposition caused by air pollution.

Infrastructure and Climatic change:

There has been a change in climate and seasonal rhythm of Patna. The majority of the populace said they are facing temperature increase in Patna MC. A total of 91% of the people surveyed said that temperature is increasing. The majority of people in each of the Western, Eastern and Central region of Patna said that they are suffering due to scorching heat and related health problems. (Fig 4).

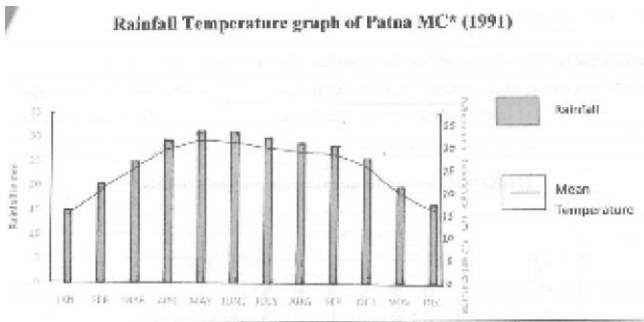
Increase in Temperature in Patna MC*



*Based on sample survey

Fig: 4

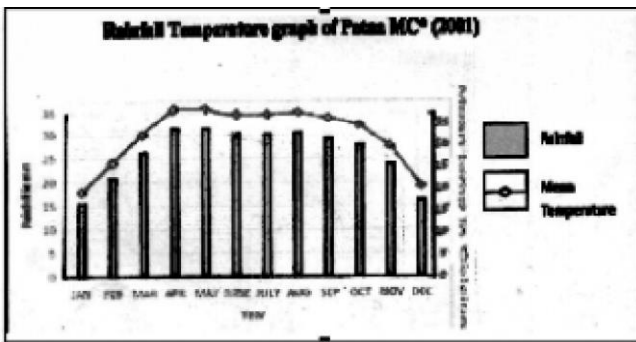
An irregular trend is seen in the average annual temperature of Patna MC from 1992 to 2011. It was highest in 1998 and 2009. In 2009 it reached as high as 26.6% and in 2011 it was 25.8%. However, it is expected to experience more extreme temperature in coming years. Since 2001 rainfall kept on decreasing. In 2011 scanty rainfall occurred in Patna MC. This trend is very frightening as in 2012, whole country received good amount of rainfall in monsoon season, thus changing Patna into an "Urban Heat Island".



* Meteorological Department of Patna, 1991

Fig: 5

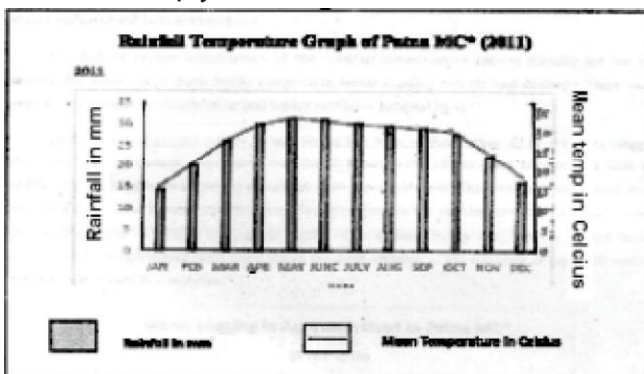
Fig 5 shows mean temperature and rainfall of Patna recorded in 1991. May was the month with the highest mean temperature as well as the highest precipitation. Gradual decrease in temperature and rainfall was observed from May to December.



*Meteorological Department in Patna, 2001

Fig: 6

From Fig 6 it is clear that April was the month with heaviest rainfall and highest mean temperature and September with the heaviest rainfall in 2001. Irregular rainfall pattern was observed throughout the year and temperature declined steeply from October to December.



*Based on data supplied by Meteorological Department in Patna, 2011

Fig: 7

In 2011, May was the month receiving the heaviest rainfall and highest monthly mean temperature. Steep decline in temperature was noticed in November & December. Irregular trend in rainfall pattern was observed from June to September.

Thus from the above temperature rainfall graph of Patna in 1991, 2001 & 2011, the changing seasonal rhythm during last 3 decades in the city can be studied.

In 1991, May was the wettest month with high mean temperature and in 2001, it was April. In 2011, again April was hottest and wettest month. Through these graphs, one can clearly observe the changing seasonal rhythm in summer months. However, not extreme variations were found in the monthly mean temperature of Patna MC 1991, 2001, 2011. Trends were largely similar.

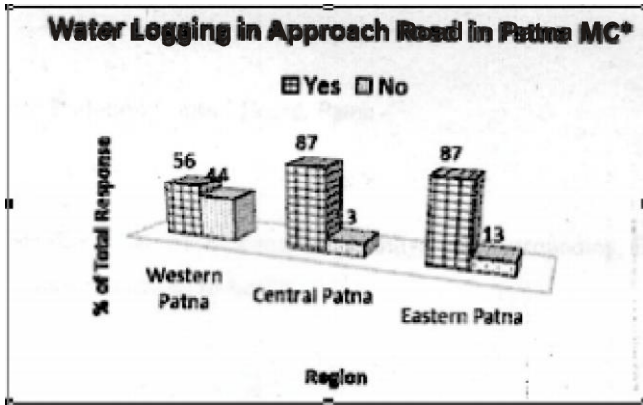
Annual precipitation increased from 1991 to 2001 but again decreased in 2011. The declining trend of rainfall is clear from rainfall data of 2012. The development of infrastructure and declining vegetation might lead to further decline in rainfall of Patna in the coming years.

Inconvenience of Infrastructure:

The lack of proper maintenance of the existing infrastructure creates menace for the city dwellers; the form varies from traffic congestion, water logging and choked drainage, poor water supply to environmental degradation and health problems induced by it. 'The volume of the garbage generated increases with the rise in population as well as improvements in standard of living' (Yadav, 2005).

On the basis of sample survey, it was found that 68% of them waste an hour due to clogged traffic and 16% of sample population sacrifice 2 hours. 77% of the total respondents face the problem of waterlogging in monsoon months in their approach roads. The condition was found much severe in Central and Eastern Patna region.

Waterlogging in the parking area and approach roads causes traffic snarls. It results into a high degree of congestion in the city, besides a huge social, economic and environmental loss. Fig 8 shows the areal variation of the condition of approach roads in Patna according to sample population.



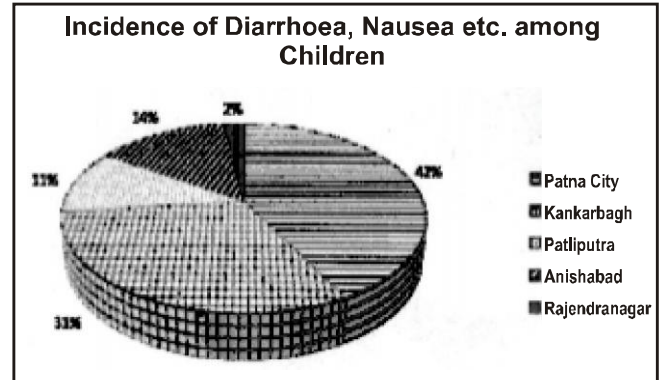
*Based on sample survey

Fig: 8

Around 60% of total wastes generated per day are left on streets which leads to drain blockages, soil and groundwater pollution and results in acute unhygienic conditions.

Health Hazards— Unprecedented populations growth has created many problems in the city. Patna 'has been labelled as' dirtiest, most congested, water logged, stinking and garbage city of India (Singh, 2005). Infrastructural development and resultant air, water and soil pollution are responsible for health hazards too. 38% of them suffered from different diseases. Of all the respondents suffering from ill-health, 36.8% of them belonged to Eastern Patna, 34.2% belonged to Central Patna and the least was recorded in Western Patna. It is probably due to relatively higher congestion and improper maintenance of infrastructure in these two regions. According to survey conducted by BSPCB in collaboration with

PMCH, the incidence of Diarrhoea, nausea etc. among children in Patna MC is clearly observable through the following diagram.



*Based on Bihar State Pollution Control Board, Patna

Fig: 9

The consequences are direct like traffic congestion, unhygienic surrounding, filthy and monotonous scenery and indirect impacts such as ill-health.

Initiatives:

Both Government and the common people are interested to take measures to ensure greenery and protection of natural environment. Various events like tree plantation, debate competition and seminars about environmental degradation and other cultural events are organized by Govt., schools, colleges, NGOs throughout the year to create awareness among the city dwellers to protect their environment and to promote the sustainable use of natural resources. Mass Rapid Transportation System (MRTS) has been introduced to avoid traffic congestion. 10 lakh saplings were distributed and 7300 saplings were planted under Green Bihar Programme. Bihar has adopted Bihar State Action Plan on Climatic Change to tackle on-going adverse climatic changes.

A students' organisation, Tarumitra works to promote Ecological Sensitivity. ECO Task Force, Patna Women's College's initiative, aims to

enhance the greenery of Patna. Green peace India launched sustainable campaign for the decentralization of renewable energy in Patna. Roundabouts have been developed as small greenbelts by different private institutions like ACC, ITC, DVC, TATA STEEL, etc. Despite all such efforts, a strategic knowledge system is essential for identifying, formulating, planning and implementing policy driven activities to protect the environment while maintaining the necessary economic growth.

Findings and Suggestions:

From the overall study of development of infrastructure in Patna, it can be concluded that recent infrastructure development especially in western Patna is impressive but not sufficient in the other two regions of Patna. Infrastructural development is both cause and effect of population growth of Patna. It has helped Patna to develop as a modern city with changing natural and social environment. Construction and poor maintenance of infrastructure is responsible for declining natural vegetation, increased SPM level, depletion and pollution of groundwater. It is changing the seasonal rhythm, bringing extremely hot summer and cold winter and declining rainfall.

To protect the environment along with keeping pace on development of Patna, plantation of trees and conservation of present greenbelt must be promoted. Ban on the use of plastics is the need of the hour. Maintenance of current infrastructure is of utmost importance to enhance the quality of life of the inhabitants of the city. Development of complementary areas is necessary to prevent migration and reduce the rate of population growth. Mass awareness at all level should be encouraged. A balance between the needs of the environment, the economy and society is a must for the sustainable development of the city.

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