URBAN WATER CRISIS IN HIMALAYAN REGION: A CASE STUDY OF KURSEONG TOWN, DARJEELING.

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Abstract
Mountains are the water tower house of the world. Himalaya mountains provide freshwater to half of Indian population. Mountains are also among the regions most sensitive to climate change. Some of the most visible indicators of climate change come from mountain areas, such as the widespread retreat of glaciers that has been observed from polar to tropical regions in recent decades. The growing raise of temperature in pre-summer and summer season in the plain areas which becomes uncomfortable condition by which people tend to visit nearby mountain stations. This causes rapid growth of urbanization and construction in mountain areas which leads deforestation. Main source of water for common people in mountain is spring/stream water which has been reported that they are drying up rapidly and bring an acute water shortage. An attempt has been made to understand water crisis of urban areas in Himalayan region. A case study had been carried out in Kurseong town, one of the rainiest site in the world, Darjeeling district, West Bengal. The town has 20 municipal wards. The study was done during 2016 through questionnaire and group discussion. From the study, it was found that 93.91 percent of household depends on municipality supply and 6.09 percent on spring/stream. But in slum areas, 33.33 percent of household depends on spring/stream. There was a huge variation of water distribution under municipality amongst wards. It was also observed the mismanagement and lack of initiative amongst the municipality staffs. In lean season, private vendors also play an important role which shares about 36.11percent.

Key words*: Mountain, Urbanization, Climate change, Water Scarcity, management and Private vendor.*

Introduction

Mountains lie in every continents of the world. The Himalaya, the Andes, the Alps, the Rockies, the Atlas, the Hindkush, the Suleman, the Kirther and the Altaintag are the major mountain ranges and youngest mountains. Mountains occupy 24 % of the global land surface. In the world, 85% of precipitation is due to orographic rainfall. So, mountain are the source of water because of which its also known as water power house. Most of the river originate from the mountain are perennial and those feed by glaciers are perennial. They have brought down sediments and get deposited formed extensive plain areas becomes most fertile place in the world that support large number of population. All these rivers has huge capacity to generate hydro power. Mountain are home of 12 % of the global population. In addition, another 14 % of the global population lives adjacent to mountain areas. Most of the people living in mountain regions are economically vulnerable and socially backward (ICIMOD 2007). The agricultural activities practice in mountain region are very rudimentary and causes lot of environmental degradation. Low production and productivity (per ha yield), home consumption of produced materials and limited access to market are the characteristics of mountain systems. The potentials to avail sustainability through enhancing and diversifying livelihood options, within the context of vulnerability and fragility of mountain terrain, have largely remained unexplored by mountain habitants. In some developed countries, mountains are hubs of horticulture and floriculture products. They also produce many valuable forest products. Its also centres of biological hotspots.

At present, mountain areas have been transforming very fast in term of infrastructural development and commodification because of change in lifestyle of mountain people as well as rapid urbanization. There is rapid growth of tourism industry in mountain region in different form of resort, scenic beauty, natural tourism adventure tourism, tracking etc. In recent years, mountains are also experiencing rapid urbanization. Due to this new development in the mountain in the form of urbanization, there has been lot of pressure in urban amenity supply. One of serious thing is supply of water in the urban areas of mountain from where water comes. On the other hand, climate change also accentuate the situation of water crisis in urban areas of mountain.

The situation is more serious in Indian mountain region of Himalaya. With the largest snow and ice cover in the world outside the polar regions, the Himalayan region is one of the most important mountain systems in the world and is referred to as the "third pole" (Schild, 2008) and the "water tower of Asia" (Xu et al., 2009). Extending along the northern fringe of the Indian subcontinent, from the bend of the Indus River in the northwest to the Brahmaputra River in the east, the Himalayas directly or indirectly affect lives and livelihood of over 300 million people (Schild, 2008). Through their massive fresh ice reserve, the Himalayas influence flow to thousands of rivers and rivulets that converge into the three main river systems in the region: the Ganges, the Brahmaputra (called Yarlung Zangbo in China), and the Indus. The Himalayas play a key role on supporting economy of nations like Nepal and Bhutan, which depend heavily on the Himalayas for hydropower, water supply, agriculture, and tourism. For example, Bhutan's export revenue from hydropower contributed 16.3% of nominal gross domestic product (GDP) or 39% of total exports in 2009/2010 (RMA, 2011). In Nepal, agriculture has remained a key economic sector, contributing about 34% of GDP in 2009 (World Bank, 2011) and employing 93% of the workforce in 2004 (ADB and IFPRI, 2009). Nepal's long term economic development plan centers on hydropower development, although current installed capacity is barely 1.5% of the total 43,000 MW potential. Himalayan States of India and Xizang Province of China also rely on hydropower, tourism, and agriculture for sustaining their economy. All these countries and states have remarkably high potential for hydropower of which only a small fraction has been harnessed. The Government of India released a study (GOI, 2012) showing that the Indian Himalayan states alone have over 70% of India's hydropower potential in terms of installed capacity greater than 25 MW.

Kurseong town is a hilly urban center of Darjeeling district, West Bengal. The urban history of the town reveals that it started in 1835 and became full-fledged urban area in 1879 when urban local body was formed. The existing urban amenities and services of the Kurseong municipality area are provided by urban local authorities as well as private vendors. Recent years due to rapid population growth in the municipality area, the demand of civic amenities and services has been increased several fold.

Study Area

Kurseong is called as "The Land of White Orchids" because it is commonly believed that the name of the town is derived from the Lepcha word "Kurson-rip" means small white orchid (Coelogyne Cristata) which grows abundantly in and around Kurseong (O'Malley, 1999).

Kurseong is located on the halfway to Darjeeling from Siliguri along the left valley side of Balason river and adjoining spur of the Senchal -Mahaldiram range in the Lesser Himalaya at an altitude of 4783 feet (1458 Metres) above the mean sea level. Kurseong is a popular tourist spot of Darjeeling hill with glimpses of glistening Mt. Kanchenjunga, Mt. Jaun and Mt. Kabru. It is also known for the place of peace, serenity and the healthy climate. The

geographical extension of Kurseong town is 26° 51' 42" N to 26° 53' 36" N latitude and 88° 15'12" E to 88° 17'32" E longitudes (Das, 2014) (Figure no 1,2,3).

Kurseong town, a small hilly urban center of Darjeeling district, was started in 1835. Kurseong town's local administrative body was formed in 1879 with a population of 2,836. The civic amenities and the infrastructural facilities were planned and installed to fulfill the needs of the population only (Lepcha, 2013). But after more than a century of population growth and urbanization, today the same infrastructure and civic amenities are supporting 42,446 populations (Census, 2011) of the town(Table no 1). Therefore, before making an effort to estimate the impact of water supply and sanitation on health like prevalence of water-sanitation related diseases in household level of Kurseong town, it may be very useful to have an idea about the present condition of water supply, sanitation.

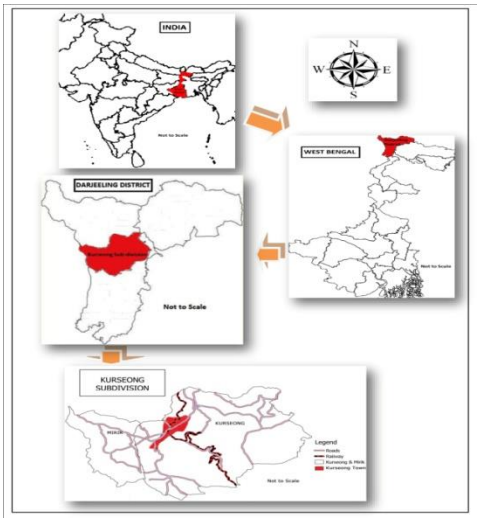

Figure 1: Location Map of Kurseong Town

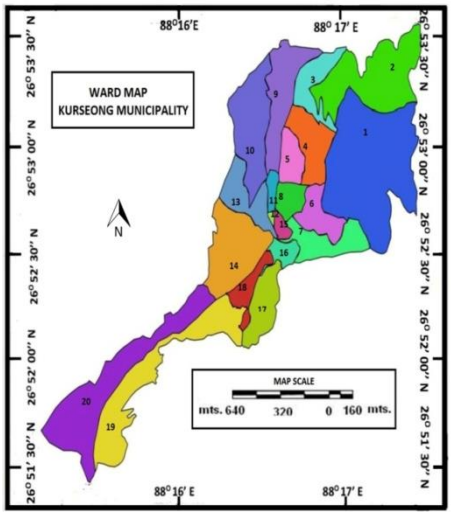

Figure 2. Ward Wise Map of Kurseong Municipality

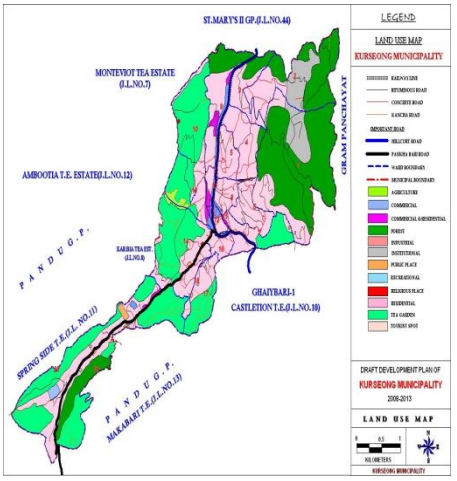

Figure No. 3: Land Used Map Kurseong Town

Table 1: Decadal Population Growth and Density in Kurseong Municipality (1901-2011)

Year	Population	Growth rate (%)	Population density (Per Sq. Km.)--
1901	4469	-	1042
1911	5574	24.7	1299
1921	6445	15.62	1502
1931	7451	15.60	1920
1941	8497	14.03	2189
1951	11719	37.91	3020
1961	13410	14.43	2655
1971	16424	22.48	3252
1981	18008	9.64	3566
1991	26758	48.59	5299
2001	40019	49.55	7925
2011	42446	6.06	5659

Source: Compiled from Bengal District Gazetteer: Darjeeling 1947.

Methodology

Both Primary and secondary were used. Primary data were collected for both qualitative and quantitative analysis. Interview, group discussion and observation methods were used to understand and assess the policy perspective of water, sanitation, hygiene and health and to formulate sustainable strategies to overcome water and sanitation related problems. Schedule was prepared with combination of open and closed end questions. For schedule 115 sample households from town were chosen base on stratified, quota and purposive sampling techniques. The survey was carried out in 2015.There are 20 (twenty) wards in the town which was categorized into four. These categories had been prepared on the basis of their activities, characteristics and function of the wards. One ward was selected for household survey from each categories area. These four categories are –

Commercial - Residential area**:** this is the CBD area of the town. This area comprises 5 ward i.e. ward no. 11, 12, 13, 14 and 15. 30 sample households were taken from ward no. 15.

Agricultural - Ecological area**:** this is the high elevated area located near to the water reservoirs. 8 wards are there in this area. They are ward no. 1, 2, 3, 7, 9, 10, 16 and 17. 20 sample households were selected from ward no. 1.

Industrial - Commercial area: this is the lower elevated area of the town. It has 2 wards i.e. ward no. 20 and 19. 20 sample households were chosen from ward no. 20.

Residential area**:** this is located just below the Agricultural-Ecological area. The area comprises with 5 wards which includes ward no. 4, 5, 6, 8 and 18. 30 sample households were selected from ward no. 4.

Sample size for household survey varies from one category to another because of the variation of population in each category. Larger the size of population, higher the number of sample size. 15 sample households were chosen from different wards which have slums population ranges from 400 to 800. Five group discussions also were conducted to find their perceptions relating to these problems. The target groups were businessmen, students, teachers, NGOs and non-formal workers. Secondary data was collected from the various journals, articles, books, annual reports, draft development project report of municipal body, statistical handbook, gazetteers, internet etc.

Finally, field study data were coded, summarized and analyzed with the help of percentage methods, average methods etc. to come up with the appropriate results and data are represented through simple diagram such as bar, pie, line graph etc.

Water Supply Condition of Kurseong Town

After Cherrapunjee in Meghalaya, Kurseong receives the highest amount of rainfall which has given birth of quite number of perennial and semi perennial sources of water in the form of natural streams. These streams are the primary sources of water in the town. Water supply in the town involves tapping of 12 natural streams in the catchment region located in the dense forest area of distances ranging from 02 to 20 Kms. The tapping water is impounded with small setting tanks. After storing in small tanks, the water is directed to the Central Reservoirs through G.I. pipe lines of various sizes for preliminary from sedimentation filtration. Then the water is supplied through the feeder conduit lines to the Service Reservoirs located at different convenient places of the municipality (Kurseong Municipality, 2012-13).

There are six central reservoirs with a total capacity of 4,838,000 gallons[1]. These reservoirs are for both urban and rural area of Kurseong. Among these central water reservoir at Durpin (Dow Hill forest area) has the highest capacity of about 45, 00,000 gallons. The water of this reservoir is always kept in reserve for maintaining supply during emergencies. Four central reservoirs have filter and chlorination device with them. These central reservoirs are central reservoir at Dow Hill near post office, Central reservoir near Victoria school, Central reservoir at Eagle Craig and Central reservoir near St. Helen's convent. Central reservoir near municipality office does not have filtration system. The present water supply infrastructures in Kurseong Town were designed and installed during the British colonial period for a population of 2836 at that time but in recent years the same infrastructures are supporting a population of 42446 (Census of India, 2011). Therefore, existing capacities of all the above reservoirs are inadequate to meet the present water demand and more severe during three lean months. Before 1980 the situation of water crisis was not that much chronic (Prasad, 2011). The estimated daily demand of the potable water is 8, 48,920 gallons (20 gallons per head per day) but in the lean driest months (March, April and May) the available water in the municipal reservoirs is 2, 89,700 gallons . Thus, there is a horrifying shortage of 5, 59,170 gallons. During the three month, the available water for the population of Kurseong town is 6.82 gallons / head.

Table No.2 : Primary Sources of Water in Different Area of the Town

Primary sources	Commercial-Residential Area	Agricultural-Ecological Area	Industrial-Commercial Area	Residential Area	Slum Area	Total
Municipality	100% (30)	90% (18)	100% (20)	100% (30)	66.67% (10)	93.91% (108)
Natural Springs	0% (0)	10% (2)	0% (0)	0% (0)	33.33% (5)	6.09% (7)
Total	100% (30)	100% (20)	100% (20)	100% (30)	100% (15)	100% (115)

Source: Household Survey, September – November, 2015.

Household data analysis

The people of Kurseong town primarily access water from two sources - municipality water supply network and natural springs/streams. Out of these primary sources, 93.91 percent of household depends on municipality supply and 6.09 percent household depends on springs/streams. Households which are getting water from springs/streams are located in Sherpa Busty (Slum area) and Ward number 1 (Agricultural-Ecological area), are getting 24 hours water in day (Table no2 and Figure no 4). The households which depend on municipality (93.91 percent) feel that they are not getting sufficient water from municipality supply. Therefore, for additional required water either they have to depend on different alternative sources like springs, river, private vendors, forest department and neighbours or they have to manage with the available water.

Table No.3 : Household Water from Primary Sources

Aspects	No. of Household	Percentage of Household
Sufficient for HH use	7	6.09%
Not sufficient for HH use	108	93.91%
Total	115	100%

Source: Household Survey, September – November, 2015.

Table No.4 : Household Manage Additional Required Water in Lean Months

Sl. No.	Household manage additional required water	No. of Household	Percentage of Household
1.	Natural springs (Dharas)	16	14.81%
2.	River (Khola)	15	13.89%
3.	Private vendors	39	36.11%
4.	Forest department	2	1.85%
5.	Neighbours	3	2.78%
6.	Manage with the available water	33	30.56%
Total		108	100%

Source: Household Survey, September – November, 2015.

Table 5 : Income Wise Household Depends on Private Sources for Additional Requirement of Water

Income wise Households group	% of household depends on private vendors for additional required water	
	Depends	Not depends
High income households	45.83% (11)	54.17% (13)
Medium income households	33.33% (15)	66.67% (30)
Low income households	28.26% (13)	71.74% (33)

Source: Household Survey, September – November, 2015.

Water purchasing procedure from the private vendors has been made through phone calls by saying exact amount of water and location. An amount of Rs. 400 per 1500 liters is charged by the vendors. Therefore, private vendors do not give at cheaper rate for the poor income family. Hence, most of the lower income households are not able to buy water from private vendor. The households which are depending on private vendors for additional

required water in lean season, are higher (45.83 percent) in high income group whereas in middle income group is 33.33 percent and in low income group is 28.26 percent (Table no 5).

People of Agricultural-Ecological area of the town collect their additional required water from the forest department officer's bungalow tap. Because the area is located near to the Forest Department. The tap is being allowed to use for local people in dry season only.

Household Pipe Water Connection: The household with pipe water connection is 74.78 percent in which 95.35% percent of household is connected with municipality water supply network and 4.65% percent with spring (Table no 6). And remaining 25.22 percent of households do not have in-house water connection.

Highest percentage of household with pipe water connection is found in Industrial-Commercial area where 90 percent of household has pipe water connection followed by Residential area (86.66 percent), Agricultural-Ecological area (85 percent) and Commercial-Residential area (63.33 percent). In Slum area only 40 percent of household has pipe water connection.

Table 6: Household Pipe Water Connection in Different Area of Kurseong Town

Water supply Characteristics	Categories of municipality area					
	Commercial and Residential	Agricultural and Ecological	Industrial and Commercial	Residential	Slum Area	Total
Household with pipe water connection	63.33% (19)	85.0% (17)	90.0% (18)	86.67% (26)	40.0% (6)	74.78% (86)
Household without pipe water connection	36.67% (11)	15.0% (3)	10.0% (2)	13.33% (4)	60.00% (9)	25.22% (29)
Total	100.0% (30)	100% (30)	100.0% (20)	100.0% (30)	100.0% (15)	100.0% (115)

Source: Household Survey, September – November, 2015.

Table 7. Household Pipe Water Connection in Different Income Background of Kurseong Town

Water supply Characteristics	Percentage of household			
	High-income household	Medium-income household	Low-income household	Total
Household with pipe water connection	100.0% (24)	84.44% (38)	52.17% (24)	74.78% (86)
Household without pipe water connection	0.0 % (0)	15.56% (7)	47.82% (22)	25.22% (29)
Total	100.0% (24)	100.0% (45)	100.0% (46)	100.0% (115)

Source: Household Survey, September – November, 2015.

After analyzing from different economic background of the sample households, it is cleared that all (100 percent) high income households are having pipe water connection while 84.44 percent in middle income and only 52.17 percent in low income (Table no 7). Therefore, highest number of lower income household i.e. 47.83 percent does not have pipe water

connection . As compare to low income households, middle income households are far better position. To get pipe water connection from municipality initially the customer has to pay Rs 6000 which is substantially expensive for low income households. As a result most of the lower income households of the town are remained out of pipe connection from municipality.

Table 8 . Gender Wise Management of Water for Household Use

Gender wise household water management	Percentage
Male	46.96% (54)
Female	43.47% (50)
Both male and female	9.56% (11)

Source: Household Survey, September – November, 2015.

Table 9. Duration of Water Supply in the Town from Municipal Network (Rainy Season)

duration of water Supply	Commercial-Residential Area	Agricultural-Ecological Area	Industrial-Commercial Area	Residential Area	Slum Area	Total
< 1 hour	100% (30)	38.89% (7)	65.0% (13)	93.33% (28)	50.0% (5)	76.85% (83)
1 -2 hours	0% (0)	22.22% (4)	35.0% (7)	0% (0)	50.0% (5)	14.81% (16)
2 – 3 hours	0% (0)	11.11% (2)	0% (0)	0% (0)	0% (0)	1.85% (2)
3 – 4 hours	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
> 4 hours	0% (0)	27.78% (5)	0% (0)	6.67% (2)	0% (0)	6.48% (7)
Total	100% (30)	100% (18)	100% (20)	100% (30)	100% (10)	100% (108)

Source: Household Survey, September – November, 2015.

Table No. 10: Income Wise Household Water Storage Capacity in Kurseong Town

Different income group of households	**Water storage capacity of the household in Kurseong town**									
	<500 Liters		**500-<1500 Liters**		**1500- <3000 Liters**		**3000 Liters and above**		**Total**	
	N	%	N	%	N	%	N	%	N	%
High Income Households	0	0%	12	50%	6	25%	6	25%	24	100%
Medium Income Households	4	8.89%	35	77.78%	5	11.11%	1	2.22%	45	100%
Low Income Household	23	50%	21	45.65%	2	4.35%	0	0%	46	100%
Total	27	23.48%	68	59.13%	13	11.30%	7	6.09%	115	100%

Source: Household Survey, September – November, 2015

Gender Wise Household Water Management

There are 46.96 percent of household in which men take responsibility to manage water while in 43.47 percent of the household women take responsibility for managing water and in 9.56 percent of the household both men and women engage for managing water (Table no 8). Men are engaged to manage household water for those areas where men power is primarily needed to fetch water. Households in which only women take responsibility for

managing water, men are either not cultured to household water management or engaged in job or other activities.

Duration of Municipal Water Supply at the Households Level

In rainy season 76.86 percent of the household gets water for less than 1 hour. And 14.81 percent of household gets water for 1 to 2 hours, whereas, 1.85 percent of household gets 2-3 hours of water supply and 6.48% household gets more than 4 hours water supply. Households which are getting more duration of water from municipality are mainly located near to the reservoir (Table no 9). Households which are getting more than 1 hour to 2 hours are high income and medium income households which have pipe connection and these households are from pure residential area. The households, which are getting more than two hours of water are in Agricultural-Ecological area with pipe connection. Therefore, it is cleared that Agricultural-Ecological area which gets highest duration of water supply in the town is located near to reservoir as a locational advantage. Whereas, Industrial-Commercial area and Slum area get less duration of water because of their location away from reservoir. Above all the duration of water supply is also largely influence by the number of connection in the ward. The wards which have more number of water connection, have comparatively shorter duration of water supply than the wards which have less number of water connection.

Water supply in dry season is found almost same. Most of the household (85.18 percent) gets water less than 1 hour. Whereas 6.48 percent households get one to two hours, 4.62 percent households get 2-3 hours and 3.70 percent households get more than four hours. And those households which are getting maximum duration of water are from Agricultural – Ecological area and Residential area.

Household Water Storage Capacity

Table 30 indicates that the storage capacity of 20 percent household of Commercial-Residential area, and 3.33 percent household of Residential area comes in the category of 3000 liters and above. Rest of the areas in the town has the storage capacity of below 3000 liters. Most of the households in the town have storage capacity of 500 - <1500 liters. In slum area the household storage capacity are found in the category of <500.

The water storage capacity is higher in high income group than middle and lower income households. The table 31 shows that 25 percent of high income household has water storage capacity of above 3000 liters while only 2.22 percent of middle income households has water storage capacity of above 3000 liters. There is no household in low income group whose storage capacity is more than 3000 liters. 50 percent of high income household of the town has water storage capacity of below 1500 liters. But in high income group, there is no household which has storage capacity of below 500 liters. Whereas, in the medium income households, the dominated water storage are in between 500 liters and 1500 liters. Half of the households of low income has been sustaining with the storage capacity of 500 liters (Figure No. 10).

Findings

The followings are few findings. Old infrastructure and significant amount of water of its wasted due to leakages. Due to population increases in urban area, demand increases. All the reservoirs are located outside of the town, therefore local people utilize the reservoir which become difficult to control such local activities. There is no meter system to monitor of water in entire water network of the town. Majority of the household of the town do not pay fees for the water they use. Due to infrequency and inadequate of water in urban area

specially in lean season, private vendors are increasing to play a part of supply of water in the town. Higher income family are better in term of water availability due to storing capacity and connectivity. Male and female are engaged in managing water for household where male role is high because of male power is required for fetching.

Conclusion

Kurseong town is a hill town in Himalaya region. The urbanization is also rapid from various factors such as subdivisional headquater, business , tourism, education, medical facility eetc. Tourism is fast growing industries because of its strategic location. It is located near to plain area of Silliguri. In the summer, people of plain mostly visit nearby hill station. Kurseong is also nearest hill station to the plain. Kurseong is also received highest rainfall in average 1,065mm in monsoon months inspites of that due to rapid urbanization in this mountainous areas, there is severe shortage of water in lean season specially. There is so abrupt change in water distribution in urban area during rainy season but due to rain the problem of household consumption is somehow cope up with rain water. There is variation of availability and frequency of water supply in different location and wards and level of economy .The municipal body is not active to handle the problems of water supply. Bribing is also practicing to get repaired and get connection. The infrastructure are getting older and need to get replace. Private vendor also should work under certain rules to monitor quality and amount per liter. Not only water supply, other urban amenities are also not fulfilled. There is also financial problem to look after all these issues. If such amenities are not addressed properly, the attraction and aesthetic beauty of the town will be degraded and it may hamper future scope of tourism industry.

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