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## STATUS OF DRINKING WATER, SANITATION FACILITIES AND HEALTH CONDITIONS IN SLUMS OF SILIGURI CITY, WEST BENGAL, INDIA

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### Abstract

*Slum is a contiguous settlement characterised by inadequate housing, lack of basic services and unhealthy environment. With the growth of cities and towns in India, the area under slums has considerably increased. In fact, rapid urbanisation caused by large influx of migrants from rural areas has been exerting tremendous pressure on existing basic services in the urban areas. Consequently, a large number of households in slum areas have been facing challenges regarding lack of proper water supply and sanitation facilities. In view of this, the present study intends to assess the availability of safe drinking water and adequate sanitation and health conditions in the slum areas of Siliguri city. The data for the study have been collected through field survey and some secondary sources. The study reveals that 84.00 per cent households from the slums of core zone, 61.50 per cent from the slums of intermediate zone and 51.50 per cent from the slums of peripheral zone have access to piped water supply. Similarly, 86.00 per cent slum households from peripheral zone have toilet in house as against 34.00 per cent from core zone and 48.00 per cent from intermediate zone. The study further reveals that the incidence of stomach and urinary problems is negatively correlated with piped water supply and availability of toilet system respectively.*

**Keywords:** Slum, Rapid urbanisation, Water supply, Sanitation, Health condition.

### Introduction

The word 'slum' is defined as informal settlement within cities with inadequate housing and miserable living conditions. Slums are often overcrowded with many people crammed into very small living spaces, poorly built congested dwelling condition, unhygienic environment usually with inadequate infrastructure and lacking in proper sanitary and drinking water facilities (Goswami and Manna, 2013). Slum formation is not a new phenomenon. It has been a part of almost all the cities in developing world. At present, one of the major challenges faced by

the urban planners globally is the proliferation of slums in urban areas and rapid growth of diverse health hazards among the slum dwellers. During last few decades, rapid urbanization of unplanned nature has resulted in the emergence of new kinds of slums. The population of slum dwellers in developing countries gradually increased from 689 million to whopping 880 million during the period of 1990-2014 (World Cities Report, 2016). As a consequence, squatter and informal housing has started expanding rapidly all around the cities of the developing world. The people in slums are mostly confronted with poor quality

of housing and lack of public and private sanitation services. Therefore, such an unhygienic living condition in slums has a direct impact on people's health.

In India also, the slum population has witnessed marked increase over the last three decades along with the growth of cities and towns. Hence, growth of urbanization and slums is a simultaneous process. The process of rapid urbanization and industrialisation contributes to massive population growth by way of large scale rural to urban migration and in turn it brings about marked increase in the growth of slums in and around the cities. Continuous inflow of migrants often exerts tremendous pressure on the public utility services in the metropolitan cities of India. The situation becomes such that the local government is unable to manage it, and the people without having an affordable place are forced to live in the slums (Chimankar, 2016). Therefore, the slum population in India has been increasing uninterruptedly at a faster rate. According to Census of India, the current slum dwelling population in the country has risen from 27.9 million in 1981 to 40 million in 2001 and to 65 million in 2011. This rapid and unplanned growth of slums in limited living spaces has visible impact on the quality of lives of the slum dwellers. The existing infrastructure and services are hard pressed to cater to the growing number of slum dwellers in the cities. Therefore, lack of basic infrastructure and basic services like availability of treated water and improved sanitation facilities add to the miseries of slum dwellers and threaten the public health (Jaiswal, 2016). Millions of slum people in India are regularly dealing with lack of clean water, sewage or waste disposal facilities and unhygienic sanitation condition. All these contribute to multiplication of urban

problems. Therefore, availability of water and sanitation is considered a pre-condition for healthy living and as such it plays an important role in improving health and quality of life (Singh and Khan, 2006; Alam et al., 2013). Eventually, slum people in large number have been often infected with various types of water-borne diseases like typhoid, dysentery, diarrhoea, etc. and it has become the cause of death of many severely affected people (Kimani-Murage and Ngindu, 2007; Momtaz et al., 2013; Allam et al., 2015). With this background, the present study is an attempt to understand the prevailing scenario of availability of safe water and sanitation facilities and their impact on the health of the slum dwellers in Siliguri city.

### Objectives

Major objectives of the study are:

- to assess the availability and quality of water at source point for consumption and problems faced in getting safe drinking water;
- to understand the prevailing sanitation facilities in terms of availability of hygienic toilet, water supply in toilet and place of waste disposal; and
- to examine the impact of water supply and sanitation facilities on health status of slum dwellers in the Siliguri city.

### Study Area

Siliguri is the sub-divisional headquarter of Darjeeling district of West Bengal. It is one of the most rapidly growing metropolitan cities. Geographically, Siliguri city is located at 26°42' N latitude and 88°26' E longitude with an area of 41.90 km<sup>2</sup> (Fig.1). The gradual merging of Siliguri city with nearby Jalpaiguri town has resulted in the emergence of it as the

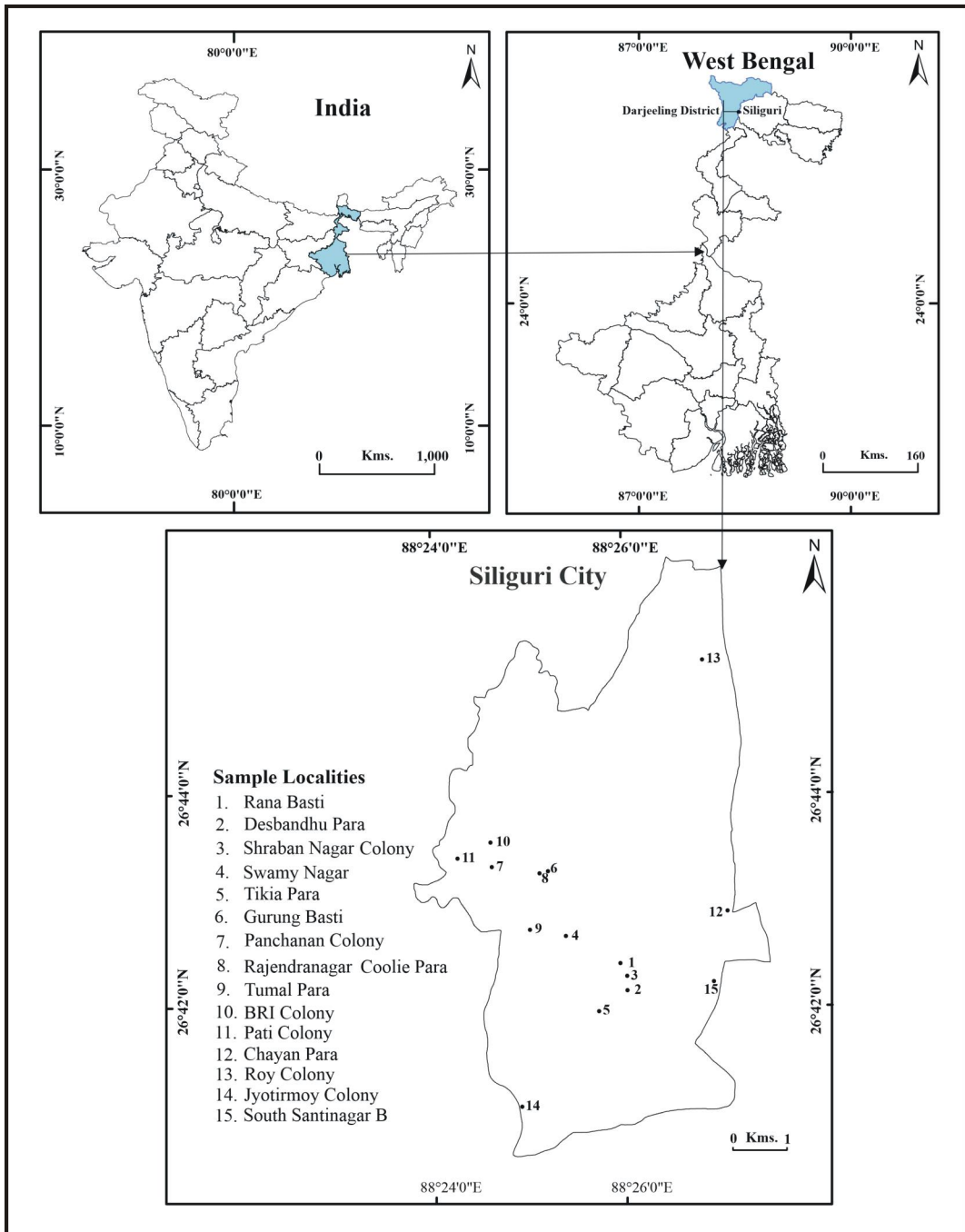


Fig. 1



largest urban agglomeration in north Bengal region and third largest city in West Bengal after Kolkata and Asansol. The whole city area is roughly bordered by four countries, viz. China, Bangladesh, Nepal and Bhutan. Besides, the city connects north-east Indian states with the mainland of India and as such it acts as a gateway to north-east India. Siliguri city also serves as a transit point to the neighbouring tourist places of Darjeeling, Gangtok and Kalimpong. In this way, the city has gradually turned into a major commercial hub of the region with its strategic location and good connectivity. The total population of the city as per 2011 Census is 5,13,264 persons with a sex ratio of 946 females per 1,000 males and a literacy rate of 85.91 per cent. The total size of its slum population is 1,75,411 persons as per 2011 Census, which accounts for 34.18 per cent of the total population of the city.

### Database and Methodology

The present study is based on both

primary and secondary data. The secondary data have been collected from Census of India publications including Town Directory of West Bengal for the period 1971-2011. The data related to slums have been collected from the report of Urban Poverty Cell of Siliguri Municipal Corporation office for the year 2017. Further, the primary data concerning water supply, sanitation facilities and status of health have been collected through stratified random sample survey. The whole city area has been divided into three zones i.e., core, intermediate and periphery on the basis of current land use pattern, population density and ward boundaries of the city. Out of total 187 slums in the study area, fifteen notified slums of Siliguri city (5 slums each from core, intermediate and peripheral zones) have been selected for field survey. From these slums, 40 households from each forming a total of 600 households have been surveyed (Table 1). In addition, the information about method of human waste disposal and perceptions

**Table 1**  
**Siliguri City: List of Slums Surveyed**

| Slums   | City Zone    | Ward No. | No. of Households Surveyed |
|---|--------------|----------|----------------------------|
| Rana Basti                                      | Core         | 18       | 40                         |
| Desbandhu Para                                  | Core         | 28       | 40                         |
| Shraban Nagar Colony                            | Core         | 20       | 40                         |
| Swamy Nagar                                     | Core         | 7        | 40                         |
| Tikia Para                                      | Core         | 28       | 40                         |
| Gurung Basti                                    | Intermediate | 3        | 40                         |
| Panchanan Colony                                | Intermediate | 1        | 40                         |
| Rajendranagar Coolie Para                       | Intermediate | 1        | 40                         |
| Tumal Para                                      | Intermediate | 4        | 40                         |
| BRI Colony                                      | Intermediate | 1        | 40                         |
| Pati Colony                                     | Periphery    | 47       | 40                         |
| Chayan Para                                     | Periphery    | 37       | 40                         |
| Roy Colony                                      | Periphery    | 42       | 40                         |
| Jyotirmoy Colony                                | Periphery    | 32       | 40                         |
| South Santinagar-B                              | Periphery    | 36       | 40                         |
| <b>Total Number of Slum Households Surveyed</b> |              |          | <b>600</b>                 |

Source: Compiled by Authors.

regarding knowledge towards the use of hygienic toilet, disease pattern and health care awareness have also been extensively collected during data collection. To examine the quality of drinking water at source, three water samples from localities like Ranabasti (Core zone), Panchanan Colony (Intermediate zone) and Jyotirmoy colony (Peripheral zone) have been collected. These samples have been tested in North Bengal Chemical Testing and Analysis Lab, Siliguri. Furthermore, Pearson's multiple correlation coefficient analysis technique has been applied to examine the relationship between water supply services and sanitation facilities with prevalent stomach and urinary problems reported by the slum dwellers. Maps and diagrams have been prepared to interpret the results.

## Results and Discussion

### Growth of Slums

Slums of Siliguri city have grown simultaneously with the growth of the city area. Rapid urbanisation and development of tourism industry has attracted large number of people to Siliguri in search of better livelihoods. It has exerted huge pressure on existing urban services with which the expansion of infrastructure could not cope with. Eventually, these poor people, who are unable to afford the

high price of land, have to live in slum or squatter settlements located near the railway line and river bank areas under very deplorable conditions. This results in the growth of slums at a faster rate in the city. The 1971 war with West Pakistan and the creation of Bangladesh made major influx of refugees in Siliguri which led to rapid growth of slum population in the town (Sarkar, 2018). As a result, the growth of unauthorized slum settlements has surprisingly increased from 23 in 1971 to 56 in 1981 (Table 2).

Increasing demand for education, establishment of new govt. offices and growth of tourism industry has greatly stimulated its economy. As a result, Siliguri city, with only 15.54 km<sup>2</sup> area in 1991 and confined to Darjeeling district, expanded to 41.91 km<sup>2</sup> in 2001 and now the city area spreads to another adjacent district of Jalpaiguri. With the expansion of the city, the number of slums increased to 154 in 2001 from 64 in 1991 by experiencing a growth of 140.63 per cent during 1991-2001. Further, the number of slums of Siliguri city increased from 154 in 2001 to 187 in 2011 with decadal variation of 21.43 per cent during 2001-11. The slum population also increased from 1,53,589 to 1,75,411 during 2001-2011, recording a growth rate of 14.21 per cent (Table 2). It is

**Table 2**  
**Siliguri City Slums: Growth and their Population, 1971-2011**

| Year | No. of Slums | Slum Population | Growth Rate of Slums (per cent) | Growth Rate of Slum Population (per cent) |
|------|--------------|-----------------|---------------------------------|---|
| 1971 | 23           | 10,000          | -                               | -   |
| 1981 | 56           | 28,000          | 143.47                          | 180.00                                    |
| 1991 | 64           | 54,958          | 14.29                           | 96.28                                     |
| 2001 | 154          | 1,53,589        | 140.63                          | 206.08                                    |
| 2011 | 187          | 1,75,411        | 21.43                           | 14.21                                     |

Source: Compiled by Authors.

thus clear that the number of slums as well as slum population of Siliguri City have been increasing rapidly over the years.

### Accessibility of Drinking Water

Water supply facilities in terms of quality and quantity are necessary to assess the living environment of the slums (Rana, 2008). Main sources of drinking water in the slums are municipal/piped water supply, hand-pumps and wells. The people either have direct connection of municipal/piped water in their house or they get it from a common municipal tap installed in the area. Similarly, some people have installed hand-pump in their houses,

while others get it from a common hand pump installed in the area. There are people who have dug well in their houses and also allow others to take water from it. In the Core zone, about 84.00 per cent households have access to piped water supply (public/private), 11.00 per cent have access to hand-pumps (public/private) and only 5.00 per cent households access water from wells. In this regard, a majority of households of Rana Basti (87.50 per cent), followed by Desbandhu para and Swamy Nagar (85.00 per cent), Shraban Nagar colony (82.50 per cent) and Tikia para (80.00 per cent) slums from the city core zone have access to piped water for drinking purpose (Table 3).

**Table 3**  
**Siliguri City Slums: Access to Drinking Water Facilities**

| Slums                     | Households per cent |              |              |                          |                              |
|---------------------------|---------------------|--------------|--------------|--------------------------|------------------------------|
|                           | Piped Water         | Hand Pump    | Well Water   | Water Source not at Home | Irregular Piped Water Supply |
| <b>Core Zone</b>          |                     |              |              |                          |                              |
| Rana Basti                | 87.50               | 10.00        | 02.50        | 20.00                    | 05.00                        |
| Desbandhu Para            | 85.00               | 10.00        | 05.00        | 35.00                    | 12.50                        |
| Shraban Nagar Colony      | 82.50               | 12.50        | 05.00        | 07.50                    | 20.00                        |
| Swamy Nagar               | 85.00               | 07.50        | 07.50        | 10.00                    | 17.50                        |
| Tikia Para                | 80.00               | 15.00        | 05.00        | 40.00                    | 22.50                        |
| <b>Total</b>              | <b>84.00</b>        | <b>11.00</b> | <b>05.00</b> | <b>22.50</b>             | <b>15.50</b>                 |
| <b>Intermediate Zone</b>  |                     |              |              |                          |                              |
| Gurung Basti              | 72.50               | 20.00        | 07.50        | 30.00                    | 12.50                        |
| Panchanan Colony          | 42.50               | 45.00        | 12.50        | 45.00                    | 42.50                        |
| Rajendranagar Coolie Para | 62.50               | 30.00        | 07.50        | 27.50                    | 22.50                        |
| Tumal Para                | 60.00               | 25.00        | 15.00        | 40.00                    | 32.50                        |
| BRI Colony                | 70.00               | 20.00        | 10.00        | 22.50                    | 17.50                        |
| <b>Total</b>              | <b>61.50</b>        | <b>28.00</b> | <b>10.50</b> | <b>33.00</b>             | <b>25.50</b>                 |
| <b>Periphery Zone</b>     |                     |              |              |                          |                              |
| Pati Colony               | 55.00               | 35.00        | 10.00        | 42.50                    | 27.50                        |
| Chayan Para               | 57.50               | 27.50        | 15.00        | 20.00                    | 25.00                        |
| Roy Colony                | 52.50               | 30.00        | 17.50        | 32.50                    | 40.00                        |
| Jyotirmoy Colony          | 30.00               | 45.00        | 25.00        | 47.50                    | 37.50                        |
| South Santinagar-B        | 62.50               | 27.50        | 10.00        | 25.00                    | 30.00                        |
| <b>Total</b>              | <b>51.50</b>        | <b>33.00</b> | <b>15.50</b> | <b>33.50</b>             | <b>32.00</b>                 |

Source: Compiled by Authors.

In the Intermediate zone, about 61.50 per cent households have access to piped water supply (public/private), 28.00 per cent access water from hand-pumps (public/private) and 10.50 per cent households have access to wells. A majority of households of Gurung Basti (72.50 per cent) followed by BRI colony slum (70.00 per cent), Rajendranagar coolie para (62.50 per cent), Tumul para (60.00 per cent) and Panchanan colony (42.50 per cent) slums from the intermediate zone have access to piped water for drinking purpose.

In the peripheral zone, about 51.50 per cent households have access to piped water supply, 33.00 per cent have access to water from hand-pumps (public/private) and 15.50 per cent households have access to well water. A majority of households of South Santi Nagar-B (62.50 per cent) followed by Chayan Para Slum (57.50 per cent), Pati Colony (55.00 per cent), Roy Colony (52.50 per cent) and Jyotirmoy Colony (30.00 per cent) slums from the peripheral zone have access to piped water for drinking purpose.

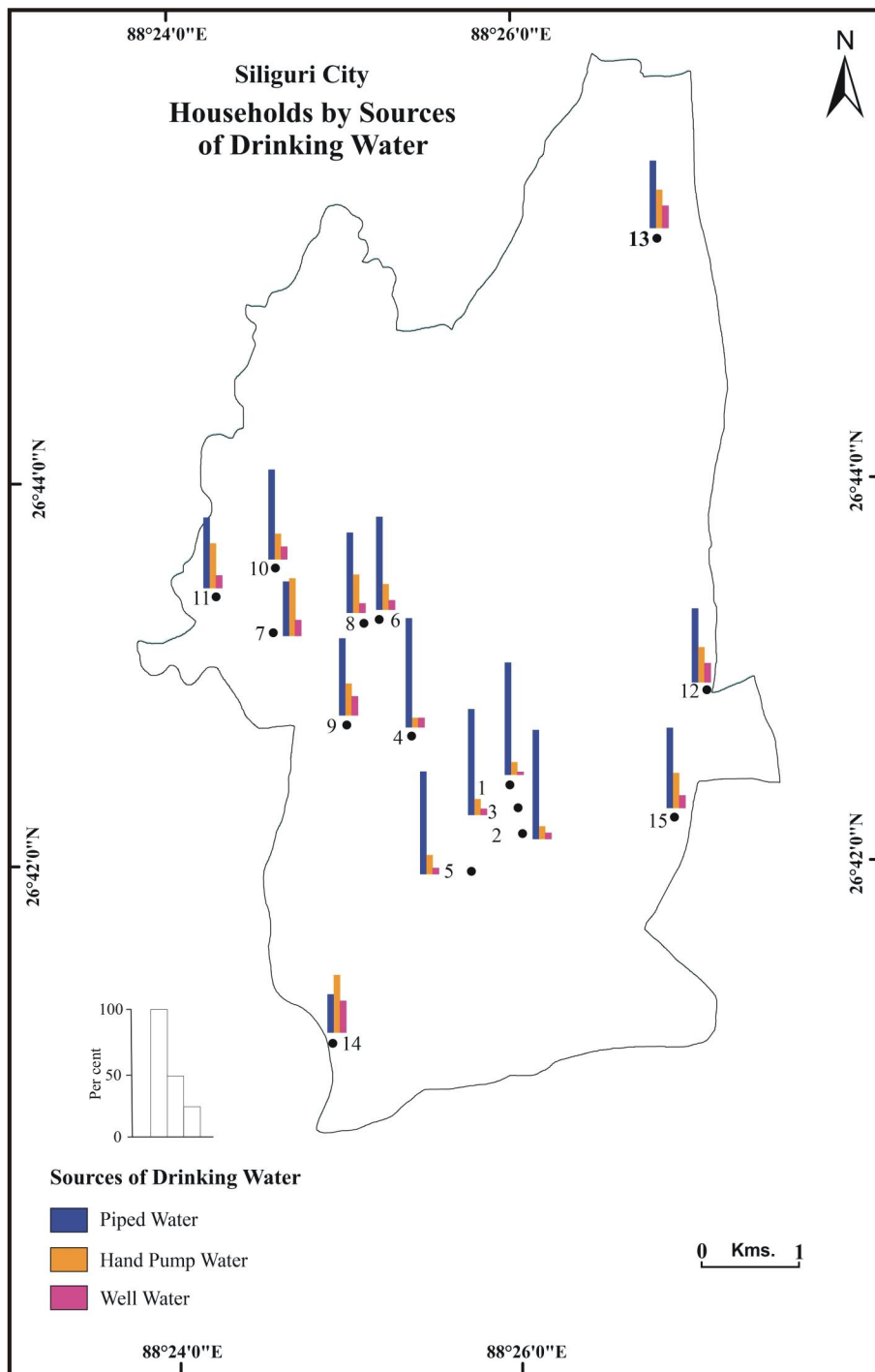
Further, a majority of households in the slums from the core and intermediate zone are depending on public sources of piped water supply as the residents of these slums have not stable income and cannot afford the expenses of having private sources of water. This signifies that public sector plays a chief role in providing infrastructural facilities in the slums of core and intermediate zones. Therefore, the involvement of public sector in water supply has made water more accessible to the slum dwellers in these two zones. On the other hand, pumps and wells are seen more in the households of the slums from the peripheral zone due to lack of piped water supply and inadequate water supply by the public sector (Fig. 2). Besides, out of the total surveyed households, a

22.50 per cent of slum households from core zone, 33.00 per cent from intermediate zone and 33.50 per cent from peripheral zone have reported that they do not have water source at home. Therefore, they have to depend on public hand pumps or neighbour's households who have their own access to water supply connections. Further, 15.50 per cent slum households from core zone, 25.50 per cent from intermediate zone and 32.00 per cent from peripheral zone have reported that piped water supply is not adequate and it becomes more irregular especially during summer season. However, slum households from peripheral zone have reported irregular and inadequate flow of piped water supply due to low pressure. Majority of them get water twice a day for 1-2 hours. Some of the households have reported that drinking water facility is above 1 km away from their house. Therefore, on an average, one and a half hours of time is daily spent for collection of water. This problem is more acute in Jyotirmoy Colony slum of the peripheral zone, where 47 per cent of slum households still depend on public or private hand pumps and private well water for drinking purpose due to absence of piped water connection.

### **Quality of Drinking Water**

To study the quality of drinking water, three water samples have been collected from the slums of the city. The source of water has been selected on the basis of maximum percentage share of households dependent on that source of water. Accordingly, piped water sample has been collected from Rana Basti slum located in core zone, hand pump water sample from Panchanan Colony located in intermediate zone and well water sample from Jyotirmoy Colony located in peripheral zone of





the city. Results indicate that the quality of piped drinking water is good in the slums of Siliguri city, as the parameters are within the desirable limit (Table 4). However, most of the households in the slums of intermediate and peripheral zones of the city depend on untreated hand pump water and well water. Therefore, water samples of hand pump water and well water have also been tested and the results indicate that the physico-chemical parameters (pH, turbidity, total dissolved solids, calcium, chloride, magnesium, sulphate and total alkalinity) have been found within the acceptable limit as per the Govt. of India norms, but iron level has been observed beyond the desirable limit. Meanwhile, it is worth mentioning that although the parameters of tested water of well and hand pump water have been found to be within desirable limit, yet there is a chance of getting it contaminated especially during monsoon when the slums located near Mahananda river bank side become waterlogged. Thus, drinking water supplied by the municipality has been found to be most suitable in the slums of Siliguri.

However, stringent timings of water supply are a common problem. Water is generally supplied during the morning or evening for 1-2 hours. This indirectly confines women in the house and debar them to take up any economic opportunity outside home. Due to such a limited supply of water, sanitation and cleanliness services are also compromised.

### Sanitation Facilities

Table 5 reveals that 66.00 per cent slum households from core zone are not having any toilet in their house and use public or community toilet or practice open defecation. Only 34.00 per cent slum households have toilet in their house. In this zone, Rana Basti recorded the highest proportion of households (92.50 per cent) using public toilets, followed by Deshbandhu Para (80.00 per cent), Shraban Nagar Colony (70.00 per cent) and Swamy Nagar (60.00 per cent) (Table 5). On the other hand, Tikia Para slum locality of Ward No. 28 has recorded the highest proportion of households having in-house toilet facility (72.50 per cent). This locality is located in the

**Table 4**  
**Siliguri City Slums: Quality of Drinking Water by Source**

| Parameters                    | Acceptable Limit in India | Observed Mean Value | Piped Water from Rana Basti | Hand Pump Water from Panchanan Colony | Well Water from Jyotirmoy Colony |
|-------------------------------|---------------------------|---------------------|-----------------------------|---------------------------------------|----------------------------------|
| pH Value                      | 6.5-8.5                   | 6.97                | 6.9                         | 7.0                                   | 7.0                              |
| Turbidity (NTU)               | 1                         | -                   | 1                           | 1                                     | 1                                |
| Total Dissolved Solids (mg/l) | 500                       | 112.67              | 38                          | 72                                    | 228                              |
| Calcium (mg/l)                | 75                        | 7.67                | 03                          | 05                                    | 15                               |
| Chloride (mg/l)               | 250                       | 26.67               | 10                          | 25                                    | 45                               |
| Magnesium (mg/l)              | 3.0                       | 1.67                | 01                          | 02                                    | 02                               |
| Sulphate (mg/l)               | 200                       | 11.67               | 05                          | 10                                    | 20                               |
| Total Alkalinity (mg/l)       | 200                       | 53.33               | 36                          | 48                                    | 76                               |
| Total Hardness (mg/l)         | 200                       | 56.33               | 19                          | 36                                    | 114                              |
| Iron (mg/l)                   | 0.30                      | 0.42                | 0.25                        | 0.35                                  | 0.65                             |

Source: Compiled by Authors.

**Table 5**  
**Siliguri City Slums: Access to Sanitation Facilities**

| Name of Slums            | Households per cent |   |  |   |   |
|--------------------------|---------------------|---|--|---|---|
|                          | Toilet in House     | Using Public/Community Toilet/Open Defecation | No Regular Water Supply at Public Toilet | Perceived Unsafe Public Toilet at Night | Disposing Child's Stool in Open Space/Drain |
| <b>Core Zone</b>         |                     |   |  |   |   |
| Rana Basti               | 07.50               | 92.50   | 65.00                                    | 70.00                                   | 27.50                                       |
| Desbandhu Para           | 20.00               | 80.00   | 52.50                                    | 55.00                                   | 20.00                                       |
| Shraban Nagar Colony     | 30.00               | 70.00   | 65.00                                    | 62.50                                   | 37.50                                       |
| Swamy Nagar              | 40.00               | 60.00   | 47.50                                    | 50.00                                   | 62.50                                       |
| Tikia Para               | 72.50               | 27.50   | 25.00                                    | 22.50                                   | 15.00                                       |
| <b>Total</b>             | <b>34.00</b>        | <b>66.00</b>                                  | <b>51.00</b>                             | <b>52.00</b>                            | <b>32.50</b>                                |
| <b>Intermediate Zone</b> |                     |   |  |   |   |
| Gurung Basti             | 62.50               | 37.50   | 30.00                                    | 20.00                                   | 17.50                                       |
| Panchanan Colony         | 77.50               | 22.50   | 17.50                                    | 15.00                                   | 05.00                                       |
| Rajendra Nagar           | 25.00               | 75.00   | 55.00                                    | 65.00                                   | 32.50                                       |
| Tumal Para               | 45.00               | 55.00   | 45.00                                    | 50.00                                   | 37.50                                       |
| BRI Colony               | 30.00               | 70.00   | 57.50                                    | 52.50                                   | 47.50                                       |
| <b>Total</b>             | <b>48.00</b>        | <b>52.00</b>                                  | <b>41.00</b>                             | <b>40.40</b>                            | <b>20.50</b>                                |
| <b>Periphery Zone</b>    |                     |   |  |   |   |
| Pati Colony              | 90.00               | 10.00   | 10.00                                    | 05.00                                   | 02.50                                       |
| Chayan Para              | 87.50               | 12.50   | 07.50                                    | 05.00                                   | 02.50                                       |
| Roy Colony               | 80.00               | 20.00   | 10.00                                    | 15.00                                   | 07.50                                       |
| Jyotirmoy Colony         | 82.50               | 17.50   | 05.00                                    | 10.00                                   | 02.50                                       |
| Souh Santinagar-B        | 90.00               | 10.00   | 02.50                                    | 07.50                                   | 07.50                                       |
| <b>Total</b>             | <b>86.00</b>        | <b>14.00</b>                                  | <b>07.00</b>                             | <b>08.50</b>                            | <b>04.50</b>                                |

Source: Compiled by Authors.

heart of the city, where people have been found to be more health conscious. Therefore, a quite high proportion of households have sanitary latrines. The position in this respect is most discouraging in Rana Basti slum located in Ward No. 18, where the proportion of households having in-house toilet facility is the lowest (7.50 per cent). It is a very old slum located in a very congested area, where hardly there is any space for building personal toilets. The prevalence of poor economic condition also compels most of the people to depend mainly on the community or public toilet

facilities.

In the case of intermediate zone, a considerably large proportion of households (52.00 per cent) do not have in-house toilets and use public or community toilets or practice open defecation. Among the different slum localities in this zone, the proportion of households using public toilet facilities have been found highest in Rajendranagar Coolie Para (75.00 per cent), followed by BRI Colony (70.00 per cent) and Tumal Para (55.00 per cent) (Table 5). On the other hand, Panchanan Colony slum located in Ward No. 1 of this zone has the highest

proportion of in-house toilet facility (77.50 per cent). This slum is located on the bank of Panchanan River and most of the households have hanging latrines in which excreta is directly disposed of in the river. The proportion of households having in-house toilet facility is the lowest in Rajendranagar Coolie Para (25.00 per cent). In view of such a situation, a majority of the households in this zone practice open defecation on the bank of the river Mahananda or use community or public toilets.

In the peripheral zone, 86.00 per cent of the households have in-house toilet facility and remaining 14.00 per cent households have to depend on public or community toilets or practice open defecation (Table 5). Among the selected localities of this zone, 90 per cent households in Pati Colony of Ward No. 47 and South Santi Nagar-B of Ward No. 36 have in house toilet facility. These localities are followed by Chayan Para (87.50 per cent), Jyotirmoy Colony (82.50 per cent), and the lowest in Roy Colony (80 per cent) (Fig. 3). As Panchanan and Jorapani rivers pass through these slums, most of the households have hanging latrines. Largely inhabited by the Bengali people, these slum localities witness awareness about the relationship between sanitation and health. In fact, the position of sanitation facility is considerably better in peripheral zone as compared to the other two zones. As a newly formed less congested slum area, the literacy rate among the slum dwellers of peripheral zone have been found to be quite high as compared to the other two zones, as a majority of them migrated to the slums of peripheral zone in search of a job.

As per the opinion of the slum dwellers, the condition of public toilet system is not satisfactory. Firstly, water supply in the public toilets is very irregular and insufficient as

revealed by 51.00 per cent of the slum households from core zone, 41.00 per cent from intermediate zone and 7.00 per cent from peripheral zone. The public toilets are not safe at night and it has been a matter of serious concern particularly for the females. About 52.00 per cent slum households from core zone, 40.40 per cent from intermediate zone and 8.50 per cent from peripheral zone of the city have reported that they feel fear using public toilets at night (Table 5). Disposal of children's excreta in open spaces and in drains is another common problem of slum areas. This practice is largely followed by the slum dwellers unconsciously. However, it is most frequent in the core zone as revealed by 32.50 per cent household respondents, followed by the intermediate zone (20.50 per cent) and peripheral zone (4.50 per cent). The practice of open defecation not only causes foul smell in and around the slum areas but it also becomes a source of ground water and surface water contamination.

### Health Condition

Health condition is a reflection of multiple factors, living environment being one of them (Chattopadhyay et al., 2016). Water supply, sanitation facility and health condition are positively correlated with each other. Water and sanitation are closely linked, as improved sanitation of a place depends on availability of water. In the same way, an improved sanitation requires a good drainage system. Whereas lack of sanitation facilities in an area adversely affects the drainage system, as drains under that circumstances are often used as dumping channels which adversely affect the health condition leading to morbidities of the slum dwellers. The slum dwellers of Siliguri are vulnerable to various physical, chemical and biological risks, as most of them are engaged in

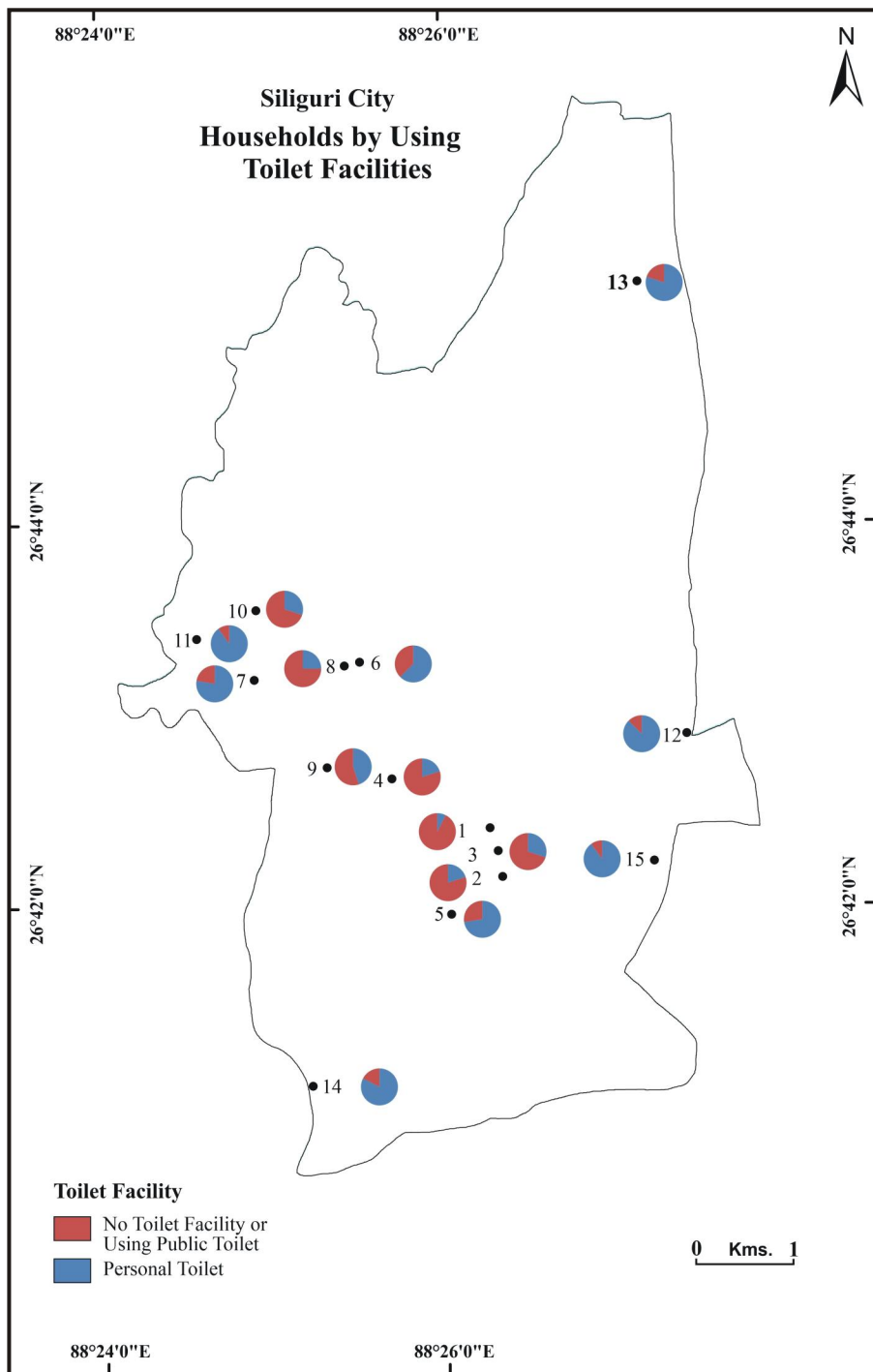


Fig. 3



daily work that involves physical labour. The study reveals that the most common health problem is associated with the stomach and is more prevalent in peripheral area than other two zones of the city as most of the households in slums of peripheral area depend on hand pump or well water rather than municipal supplied piped water. About 24.50 per cent households from core, 30.50 per cent households from intermediate zone and 44.50 per cent households from peripheral zone reported stomach problems like diarrhoea, constipation, bloating, heart burn, nausea, incontinence problem associated with liver and intestines etc. (Table 6).

Second major health problem is

musculo-skeletal which is more common in the intermediate and peripheral zones than the core area. This may be due to excessive physical activity, inflammation from any infection or muscle tension. As most of the respondents from Gurung Basti, Rajendranagar Coolie Para and Chayan Para from intermediate and peripheral zones are engaged in works related to continuous posture of carrying and pulling heavy loads near Siliguri town station and junction railway station areas. Another basic problem is associated with respiratory tract including cough, cold, fever, breathing problem, respiratory allergy etc. It is comparatively higher among the people living in core (16.00 per cent) and intermediate area (17.00

**Table 6**  
**Siliguri City Slums: Incidence of Reported Morbidities During Past One Year**

| Name of Slums            | Households per cent |                     |                          |                          |              |               |                 |
|--------------------------|---------------------|---------------------|--------------------------|--------------------------|--------------|---------------|-----------------|
|                          | Stomach Problem     | Respiratory Problem | Cardio Vascular Diseases | Musculo Skeletal Problem | Thyroid      | Skin Diseases | Urinary Problem |
| <b>Core Zone</b>         |                     |                     |                          |                          |              |               |                 |
| Rana Basti               | 32.50               | 22.50               | 07.50                    | 25.00                    | 07.50        | 02.00         | 20.00           |
| Desbandhu Para           | 15.00               | 12.50               | 05.00                    | 32.50                    | 12.50        | 07.50         | 15.00           |
| Shraban Nagar Colony     | 20.00               | 17.50               | 05.00                    | 15.00                    | 05.00        | 05.00         | 12.50           |
| Swamy Nagar              | 25.00               | 15.00               | 02.50                    | 10.00                    | 07.50        | 02.50         | 07.50           |
| Tikia Para               | 30.00               | 12.50               | 05.00                    | 17.50                    | 05.00        | 07.50         | 10.00           |
| <b>Total</b>             | <b>24.50</b>        | <b>16.00</b>        | <b>05.00</b>             | <b>20.00</b>             | <b>07.50</b> | <b>05.00</b>  | <b>13.00</b>    |
| <b>Intermediate Zone</b> |                     |                     |                          |                          |              |               |                 |
| Gurung Basti             | 22.50               | 20.00               | 07.50                    | 45.00                    | 02.50        | 10.00         | 10.00           |
| Panchanan Colony         | 50.00               | 05.00               | 05.00                    | 27.50                    | 05.00        | 02.50         | 07.50           |
| Rajendra Nagar           | 27.50               | 22.50               | 12.50                    | 45.00                    | 02.50        | 07.50         | 12.50           |
| Tumal Para               | 35.00               | 25.00               | 02.50                    | 37.50                    | 10.00        | 02.50         | 15.00           |
| BRI Colony               | 17.50               | 12.50               | 17.50                    | 25.00                    | 05.00        | 15.00         | 12.50           |
| <b>Total</b>             | <b>30.50</b>        | <b>17.00</b>        | <b>09.00</b>             | <b>36.00</b>             | <b>05.00</b> | <b>07.50</b>  | <b>11.50</b>    |
| <b>Periphery Zone</b>    |                     |                     |                          |                          |              |               |                 |
| Pati Colony              | 50.00               | 07.50               | 02.50                    | 15.00                    | 02.50        | 07.50         | 07.50           |
| Chayan Para              | 37.50               | 05.00               | 15.00                    | 37.50                    | 07.50        | 05.00         | 02.50           |
| Roy Colony               | 45.00               | 10.00               | 05.00                    | 25.00                    | 05.00        | 02.50         | 05.00           |
| Jyotirmoy Colony         | 57.50               | 15.00               | 07.50                    | 10.00                    | 07.50        | 07.50         | 10.00           |
| South Santinagar-B       | 32.50               | 10.00               | 05.00                    | 27.50                    | 10.00        | 02.50         | 05.00           |
| <b>Total</b>             | <b>44.50</b>        | <b>09.50</b>        | <b>07.00</b>             | <b>23.00</b>             | <b>06.50</b> | <b>05.00</b>  | <b>06.00</b>    |

Source: Compiled by Authors.

per cent) than the peripheral area (9.50 per cent) due to indoor and outdoor urban pollution. Another most common problem is cardiovascular disease, which is significantly higher in intermediate and periphery area than core area due to their unhealthy lifestyle, unhealthy diet, and consumption of alcohol. As about 9.00 percent households from intermediate area and 7.00 per cent from peripheral area reported cardiovascular problem related to high blood pressure, disorders of heart and blood vessel etc. Similarly, 7.50 per cent households from core area reported thyroid or gland problems, while 5.00 per cent households from intermediate and 6.50 per cent households from peripheral area have informed about the thyroid disorder due to stress and high cholesterol level. Apart from this, the study reveals that 7.50 per cent households from intermediate zone are having skin disease, which is higher than the core and peripheral areas. The slums of this zone are located along the river and most of the households use contaminated river water for domestic purpose (washing and bathing) on daily basis. About 13.00 per cent of households from core area and 11.50 per cent households from intermediate area have reported that they are suffering from urinary problems. It is due to the fact that the households from the core and intermediate areas use unhygienic public toilets with insufficient water supply.

### **Relationship between Water Supply, Sanitation Facilities and Morbidities**

The relationship between water supply and sanitation facilities with reported morbidities (stomach problem and urinary problem) have been examined by using multi-linear relationship. The study reveals that the problem of stomach disorders is negatively

correlated ( $r = -0.84$ ) with piped water supply. It is significant at 5 per cent level of confidence, suggesting that with the drinking of municipality supplied water, the risk of stomach disorder declines among the slum households in the city. On the other hand, hand pump water ( $r = 0.84$ ) and well water ( $r = 0.72$ ) are positively correlated with stomach problem. It is significant at 1 per cent level of confidence suggesting that the use of hand pump and well water for drinking purpose on regular basis may cause higher risk of stomach problem (Table 7).

Most of the slum households from intermediate and peripheral areas use hand pump or well water for drinking purpose. Therefore, they have been found to be suffering from stomach disorder related issues like abdominal pain or cramps, gastro-oesophageal reflux disease, diarrhoea, ulcers, nausea, vomiting etc. Likewise, other factors such as, water source not at home ( $r = 0.62$ ) and the irregular water supply ( $r = 0.75$ ) are positively correlated with stomach problem. It is significant at 1 per cent level of confidence suggesting that these two factors may raise the risk of stomach problem. Moreover, water source not at house and irregular water supply predominantly affect women and children by putting physical and economic burden on them. As most of the women in the household with no source of water have to cover long distance to fetch water from the nearest safe water source like public or community water tap regularly repeating the journey up to two times a day. Most of the women in slum households from the peripheral area in Siliguri have to walk for more than 30 minutes to collect water, and the volume of water brought gradually decreases with distance. Limited water availability also reduces the amount of

Table 7

**Siliguri City Slums: Correlation Matrix of Water Supply Facilities and Stomach Problem**

| Source of Water          | Piped Water | Hand Pump Water | Well Water | Water Source not at Home | Irregular Water Supply | Stomach Problem |
|--------------------------|-------------|-----------------|------------|--------------------------|------------------------|-----------------|
| Piped Water              | 1.00*       |                 |            |                          |                        |                 |
| Hand Pump                | -0.97**     | 1.00*           |            |                          |                        |                 |
| Well Water               | -0.88**     | 0.74*           | 1.00*      |                          |                        |                 |
| Water Source not at Home | -0.64**     | 0.66*           | 0.48*      | 1.00*                    |                        |                 |
| Irregular Water Supply   | -0.85**     | 0.81*           | 0.77*      | 0.55*                    | 1.00*                  |                 |
| Stomach Problem          | -0.84**     | 0.84*           | 0.72*      | 0.62*                    | 0.75*                  | 1.00*           |

Source: Compiled by Authors. \*Significant at 1 per cent level; \*\*Significant at 5 per cent level.

water that is used for maintenance of hygiene among such slum dwellers which also affects their health.

The results of the relationship between sanitation facilities and urinary problem also indicate the prevalence of urinary tract infection like pain in bladder or lower abdomen, frequent urination, cramping or vaginal irritation etc. This problem is very common among the slum dwellers using public toilet. The study reveals that the urinary problem is negatively correlated ( $r = -0.83$ ) with toilet in house (Table 8). It is significant at 5 per cent level of confidence, suggesting that using toilet in house may prevent the risk of urinary problem of the slum dwellers.

The problems of urinary infection are not a major issue among the slum households in peripheral area of the city as most of the slum households from peripheral area are having toilet facilities at home. Meanwhile, other factors like using public toilet ( $r = 0.84$ ) and no regular water supply at toilet ( $r = 0.79$ ) are positively correlated with urinary problem. It is significant at 1 per cent level of confidence, suggesting that using public toilet and no regular water supply at toilet also increases the chances of getting urinary infection. For instance, a majority of households from core and intermediate area of the city are facing the problems of urinary infection as most of the households have no toilet at home and have to

Table 8

**Siliguri City Slums: Correlation Matrix of Sanitation Facilities and Urinary Problem**

| Use of Toilet                            | Toilet in House | Using Public Toilet | No Regular Water Supply at Public Toilet | Public Toilet Perceived Unsafe at Night | Urinary Problem |
|--|-----------------|---------------------|--|---|-----------------|
| Toilet in House                          | 1.00*           |                     |  |   |                 |
| Using Public Toilet                      | -1.00**         | 1.00*               |  |   |                 |
| No Regular Water Supply at Public Toilet | -0.97**         | 0.97*               | 1.00*                                    |   |                 |
| Public Toilet Perceived Unsafe at Night  | -0.97**         | 0.97*               | 0.97*                                    | 1.00*                                   |                 |
| Urinary Problem                          | -0.83**         | 0.84*               | 0.79*                                    | 0.80*                                   | 1.00*           |

Source: Compiled by Authors. \*Significant at 1 per cent level; \*\*Significant at 5 per cent level.

use badly maintained and overcrowded community or public toilets, or practice open defecation. Again, perceived unsafe, public toilet at night is also positively correlated with urinary problem ( $r = 0.80$ ). The positive relationship between the two suggests that the slum dwellers have to refrain from urinating and defecating for many hours, thereby causing higher risk of urinary tract infections.

### Conclusions

This study reveals that the slum population has grown at a faster rate in comparison to the growth of the urban population in Siliguri city. However, the water supply and sanitation conditions have not improved accordingly. A majority of slum people from intermediate and peripheral zones are still using hand pump water or well water for drinking purpose. The toilet with hygienic condition and other related facilities have been found to be extremely poor in most of the slum households especially in core and intermediate zones. Again, a significant proportion of slum dwellers from core and intermediate zones have been found to be habituated to open defecation and disposal of children's excreta in open drain or open space. This has become a cause of both surface and ground water contamination along with soil pollution. The frequent occurrence of infectious diseases including cholera, typhoid, hepatitis, malaria, dengue, etc. are associated with soil and water contamination. In view of such a serious situation, the various government agencies and NGOs have to work in coordination towards maintaining healthy living condition along with adequate provision of water and sanitation in the slum areas. Moreover, specific rules and regulations need to be implemented by the govt. to provide adequate water supply and

sanitary facilities in each and every household of the slums. In addition, awareness programme towards maintaining cleanliness and healthy living among the slum dwellers in the city would constitute an added strategy for a sustainable development of Siliguri city.

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