

Survey on Drinking Water Supply Management and Mitigation of Waterlogging Problems in Bolpur Municipality of Birbhum District, West Bengal, Since Last Three Decades (1991 To 2011)

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I. INTRODUCTION

Bolpur Municipality of Bolpur-Sriniketan C.D. Block in Birbhum District of West Bengal, India, first emerged as an important municipal town on 12th June'1950. Historically, Bolpur was always in limelight during late British colonial period in undivided Bengal and it only after Maharshi's (Maharshi Debendranath Tagore, father of Kaviguru Rabindranath Tagore) foundation of Santiniketan (the abode of peace) it slowly flourished as tourist destination center in Indian Tourist Map. Before the making of Santiniketan, Bolpur was just known as an unimportant railway station along the loop-line tract of Eastern Railways. But in due course of time, with increase in population and emergence of Bolpur as the most important trading center of its hinterlands like Nanoor, Sriniketan etc. it became the focal center of the gram Panchayats of today's Bolpur-Sriniketan C.D. Block areas. Civic amenities also have been going through enormous of changes in response to transportation and communication also. At present, this Grade-III municipal town (as per the standard of Govt. of W.B.) is till now serving as the gateway of and the inseparable auxiliary serving town to Santiniketan Heritage Complex, the most promisingly emerging international tourist destination. But any traditional developmental programmes implemented in an unplanned or haphazard growth of markets or housing areas can also bring some adverse environmental effects such as poor quality of civil amenities can bring uncomfortable living standard. For instance, increasing problem of the scarcity of water during dry period sustained even after the successful implementation and execution of the PHE projects. On the other hand, the awkward waterlogging conditions not only during heavy spells but also persisting even during very little amount of rain in different wards of this municipal area. To find out these emerging issues and to combat these water-related urban problems of Bolpur Municipal area, a detailed ward-wise field survey has been done by the students of Semester-V (Honours) of 2018-19 of Department of Geography of Sambhu Nath College, Labpur, Birbhum in West Bengal. Though the period of this survey was too short to be completely done, the students have tried their level best to observe, understand, analyzed the present water related issues and have put forth some propositions as much as they could. The entire field word has been divided into three sections which are discussed next.

Hypothesis:

- I. Water scarcity and Water logging are common natural phenomenon in every municipal area of Birbhum district in West Bengal, India (H_0).
- II. Water scarcity and Water logging are not common natural phenomenon and anthropogenic factors are mainly responsible for those in every municipal area of Birbhum district in West Bengal, India (H_1).

Objectives: Every field study starts with some objectives as expected and here the following objectives are –

- (i) To understand the seasonal scarcity of potable water along with annual waterlogging problems since last three census decades in Bolpur Municipality.
- (ii) To search for the factors working behind the waterlogging problems(s) in Bolpur Municipality area.
- (iii) To prepare a multi-dimensional plan to check the waterlogging and to cater the water surplus water of rainy season to check the scarcity of water in Bolpur Municipal area in Birbhum district of West Bengal.

II. METHODOLOGY

Every geographic field survey has its own methodological perspectives. In this survey we have followed the below mentioned methods to collect, store, process, analyze, interpret the data related to the selected topic through hierarchical processes-

I. Pre-Field:

- Relevant and official Cadastral Maps from Office of Bolpur Municipality, SOI Toposheet (No.73 $\frac{M}{10}$ or F45D10) and Satellite imageries (including LISS-III of 2008, 2012, 2016 and DEM of 2015) and older published maps from different books, journals (both offline and online) have been collected and been minutely studied georeferencing them with the help of QGIS ver. 3.8.3.
- Germin GPS has been used to avoid RMS error of the rectified raster images of Bolpur municipal area and its surroundings.
- Slope Map with the help of DEM was prepared to calculate the average slope of the area.
- Previous Literatures related to the topic has been studied in detail.
- Questionnaires were prepared to get the public perceptions on water scarcity and water-logging problems in all wards of Bolpur Municipality area.

II. Field:

- Sample Survey Stations were selected (mainly on the basis of permanent structures like primary school, road junctions, hospital ect.) after dividing the entire Municipality into four quadrants i.e. NE, SE, SW and NW.
- Small groups of 4-5 students started surveying quadrant-wise allotted wards with Toposheet, Satellite image, Slope map and questionnaire maintaining the framework of the field-survey.
- Randomly at least 30 households were surveyed where water-logging persists predominantly.
- Different sizes and shapes of household and surface water draining drains or nalas were observed, sometimes measured (when needed) and snapped for future analysis with coordinates of each.
- Road conditions were verified with the data obtained from PWD section of Bolpur Municipality Office, and waste-disposal management of each ward was surveyed in detail.
- Conditions and number of municipal water-taps were evaluated and counted in compliance with the data obtained from PHE section of Bolpur Municipality Office.
- All the large water tanks were observed and their functioning was also recorded in datasheet.

III. Post-Field:

- All sub-topic-wise data and information were collected and sorted, filtered and arranged according the need for processing and analysis.
- Window Excel 2007 was used for tabulation of the collected data and different statistical techniques like central tendencies, standard deviation, Karl Pearson's correlation-coefficient etc. were applied to formulate the data and to get the ultimate result.
- With the help of QGIS (ver. above 3.0) open source software, the spatio-temporal changes of the LULC of the Bolpur Municipality was analyzed and cross-checked with the statistical result of the ground data.
- Revisiting of the sites was done when any kind of anomaly in data was found.
- Finally, interpretation was done.

III. LITERATURE REVIEW

Literature review is the most essential part of any field survey as the previous works on the said topic helps the surveyor to update or modify and apply the data collected according to the objectives of field study. The following works on Bolpur Municipality of Birbhum District which have been studied to get sufficient previous knowledge regarding the issues concerned. In 1997, SSDA of Birbhum District in West Bengal published a detailed report on Bolpur-Sriniketan Block of Birbhum District describing the Structure of Bolpur Municipality, its area, roads, civic amenities and past conditions. It was report on land use and development control plan. In a published article entitled 'Urbanisation And Sustainable Development: An Environmental Study of Bolpur Town Near Tagore's Santiniketan, West Bengal, India 2010' the socio-economic status of Bolpur Municipality was dealt by Dr. P. Basu Roy of Alipurduar College of West Bengal where the main theme was the environmental problems and its causes in Bolpur Municipality. In 2013, another official task after the SSDA was taken up by the BAE and Statistics of Birbhum district, Suri, Birbhum which was mainly dealt with the population facts of Bolpur Municipality and its demographic details in the form of District Census Handbook. Again, in May, 2016, the SSDA, Birbhum of West Bengal published a report on 'Revised Land Use & Development Control Plan-2025 For Sriniketan-Santiniketan Planning Area' where it dealt with the Climate, Water Supply, Soil types of Bolpur Municipality and Future Conditions of Bolpur And Santiniketan Block. Another major work has been reviewed i.e. 'The Nature of Solid Waste Disposal in Bolpur

Municipality, Birbhum, West Bengal’ by Dr. Sanchita Saha, Ex-Research Scholar, Dept. Of Geography, Visva-Bharati, Santiniketan, West Bengal, India in August ,2018. She discussed on the Garbage and Waste conditions, problems of Bolpur Municipality, Drainage Problems.

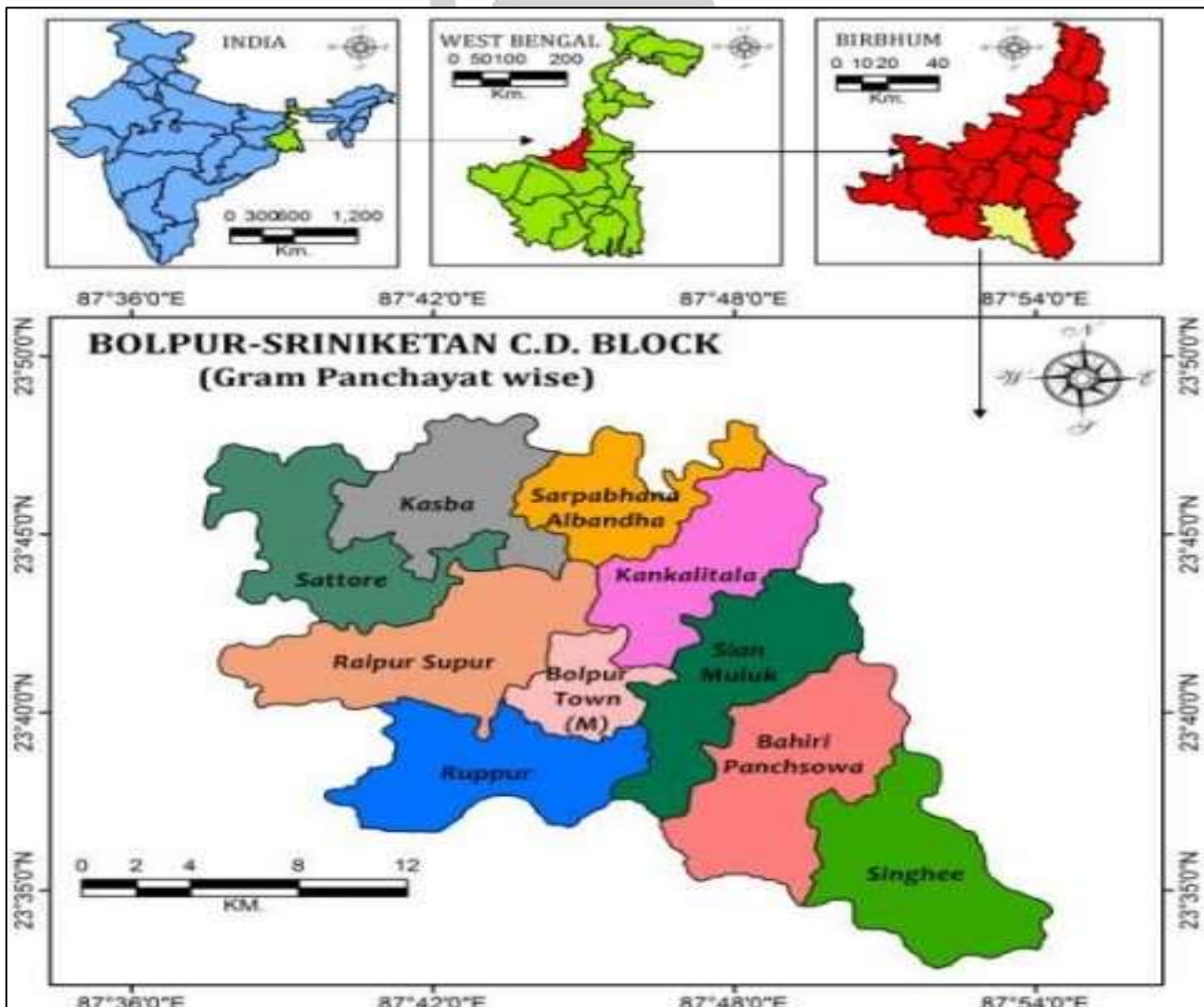
Location of the Study Area: The Bolpur Municipality (23.6431° N - 23.69870° N & 87.71323° E – 87.77294° E) with its 18 wards (fig. 3) is located to the SSE (south-south east) part of Birbhum district (approximately 23°32'N- 24°35'N & 87°05'E- 88°00'E) in West Bengal, India (fig.1) covers an area of 13.13 km² (as on Census 2011) within the Ajay River Basin arena. Ajay flows on the southern part of it and Kopai to the northern part of it. Kopai south-east main canal passes through the north of this municipality. The Sahibganj loop line has divided this municipal area into east and west halves (fig. 3). This municipality is delineated by Sian-Muluk Gram Panchayat to its east, Ruppur Gram Panchayat to its south, Raipur-Supur to the west, and Santiniketan, Prantik township and Kankalitala Gram Panchayat to its north and north-east (fig. 3).

Geology and Topography: According to NATMO record (2009), the district of Birbhum (part of Rarh Plain) in West Bengal is geologically structured by Archaean Gneiss, Upper Carboniferous Sedimentary rocks and older with newer alluvium. The landscape of this municipal area is quite similar to other Rarh areas of Murshidabad, East Barddhaman, Bankura and West Midnapore. The town area is mainly profiled by older alluvial soil and partly by laterites. Average elevation of this area ranges between 40m-60m from MSL with B.M. of about 50 m (table-1).

Table-1: Elevation zones of the Bolpur Municipal area.

Elevation Zones	Wards Numbers
< 40m	1, 2, 3 & 4
42m-50m	6, 7, 8, 10, 11, 12, 13, 15, 16, 17, 18, 19 & 20
50m-58m	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16 & 18
> 58m	11, 17, 18, 19 & 20

Source: DEM, 2010



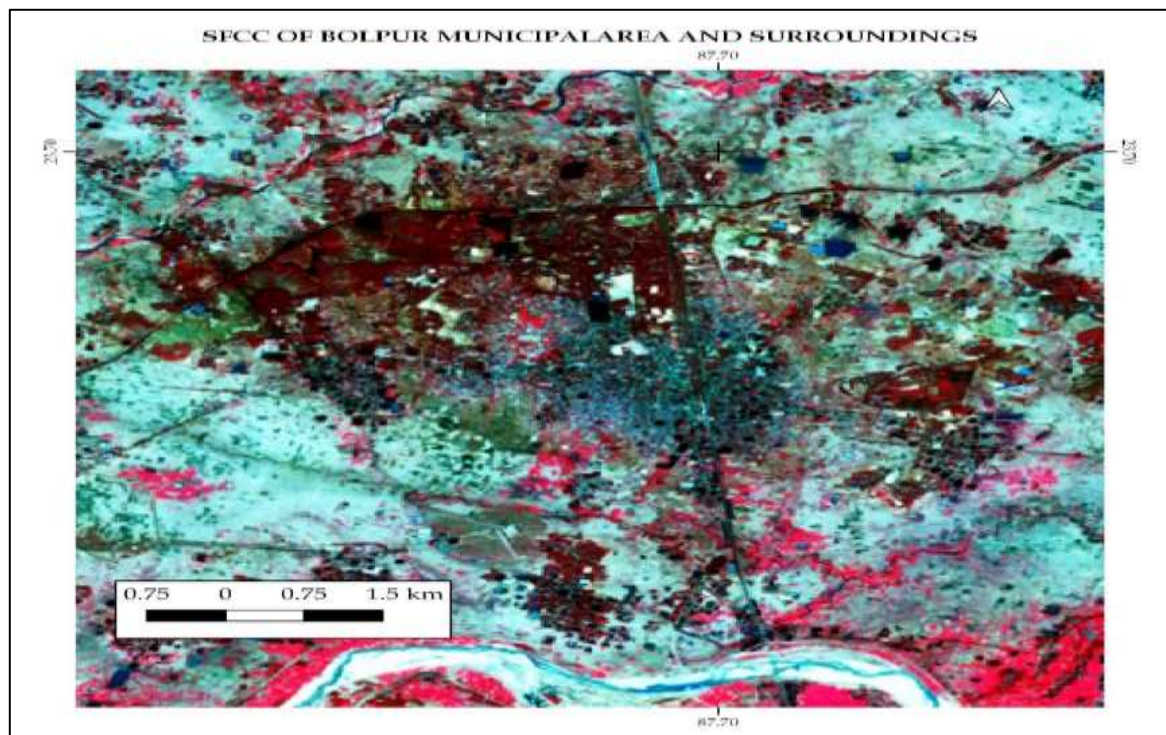
Source: Office of the Bolpur Municipality (2019)

fig. 1 Location of Bolpur Town (M) in Bolpur-Sriniketan Block of Birbhum district in West Bengal, India (2011)



Source: Department of Geography, S.N. College, Labpur

fig. 2a Toposheet (extracted from Toposheet No. No.73 $\frac{M}{10}$ or F45D10 showing the Bolpur Municipal area and its surroundings)



Source: Department of Geography, S.N. College, Labpur, Birbhum

fig. 2b, Standard False Colour Composite image of Bolpur town and its surroundings

Hydrological Environment: The ground water potentiality (yield in litre/sec) of Bolpur town and its surroundings is about 1-5 litre/sec. Aquifers with intergranular porosity and fractures are predominant here. Tertiary and Pleistocene deposits are mostly covered by a variable thickness of laterite which even envelopes some portions of the peneplained and highly weathered gneissic terrain to the west. The hollows between the ridges form natural drainage channels, out of which the wider valleys are streams of considerable volume and in a few cases expand into broad rivers, which even within Bolpur have a small and shallow current throughout the greater part of the year.

Relief of the study area: The general gradient of this municipal area is from north-north west to south-southeast (fig. 4). The Sal or Kopai Nadi (named after Tagore) meanders in a semi-circle from west-north-west to east-south-east and creates scars of gully erosion forming the badland topography to the north of Santiniketan which has a great significance from tourism point of view. The Makrampur area (fig. 2b & 3) in Ward no. 1 (to the north-north east of Bolpur Municipality), the badland topography along the banks of the Kopai Nadi can be noticed here and there.

Drainage system: From previous literatures of Tagore, it has been found that the Kopai Nadi in earlier days had quite control over the drainage system of Bolpur-Santiniketan area. At present, the

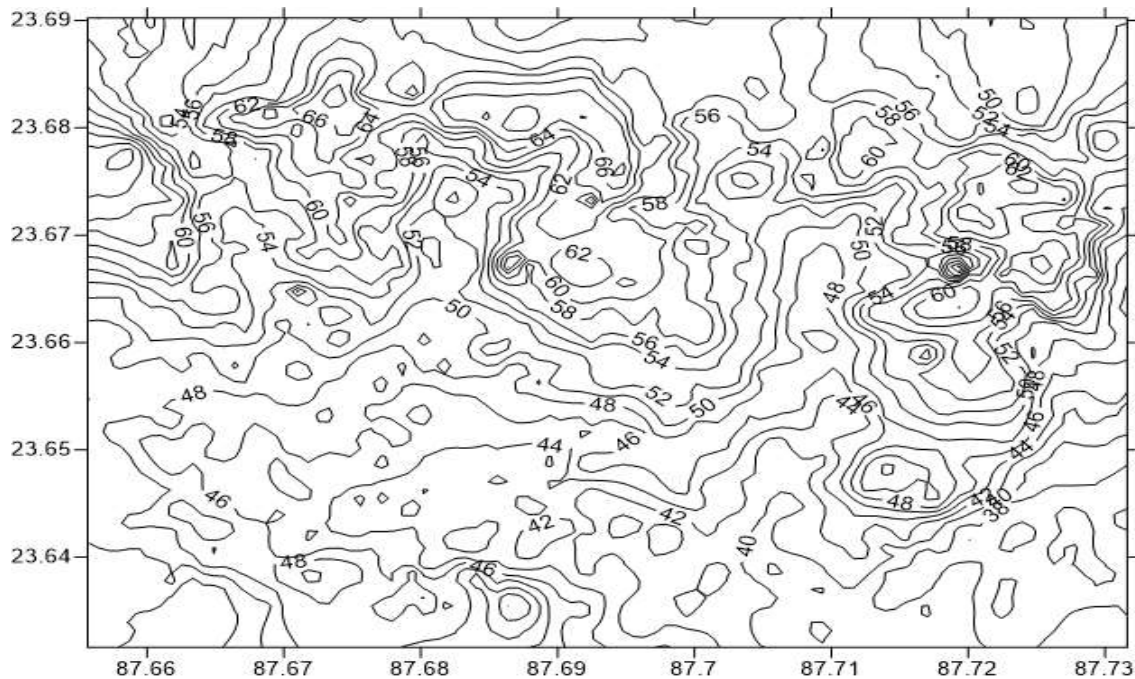
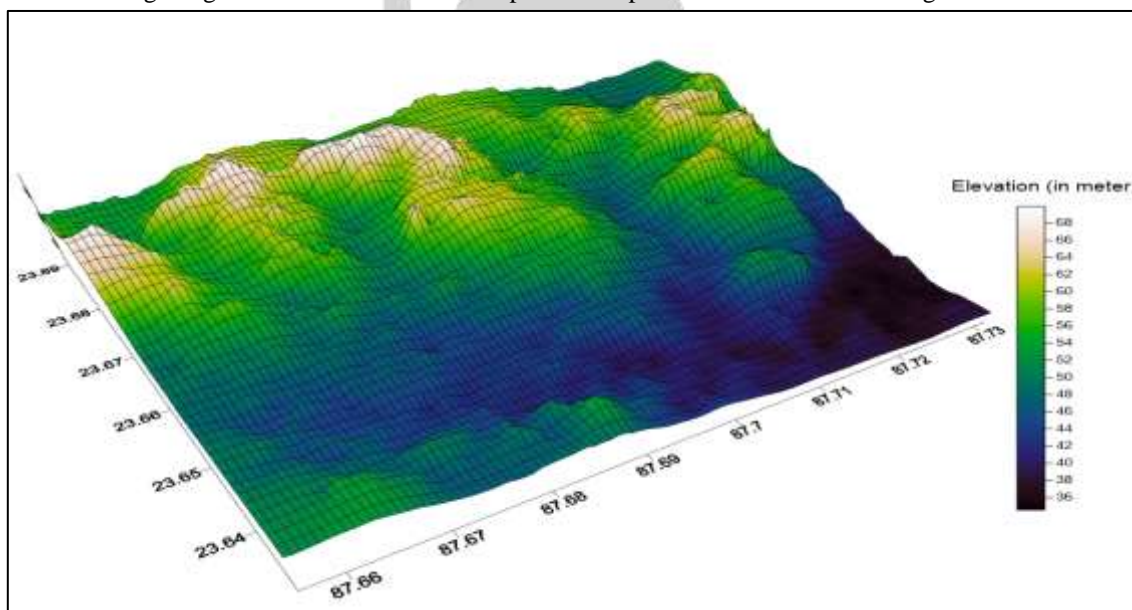


fig. 3: Contours showing the general relief features of Bolpur Municipal areas and its surrounding area.



Source: Compilation of fig. 3 with DEM (cdfn45D.tif), Bhuban, NRSC, Govt. of India (exaggerated)

fig. 4 : DEM of Bolpur Municipal area and its surroundings.

leaning discharge of Kopai and Ajoy along north and south of Bolpur town respectively during the winter and summer months do not promise to supply sufficient sub-surface discharge to refill the ground water beneath this area. But during rainy season, the temporary short streams within Kopai and Ajay form micro-drainage systems.

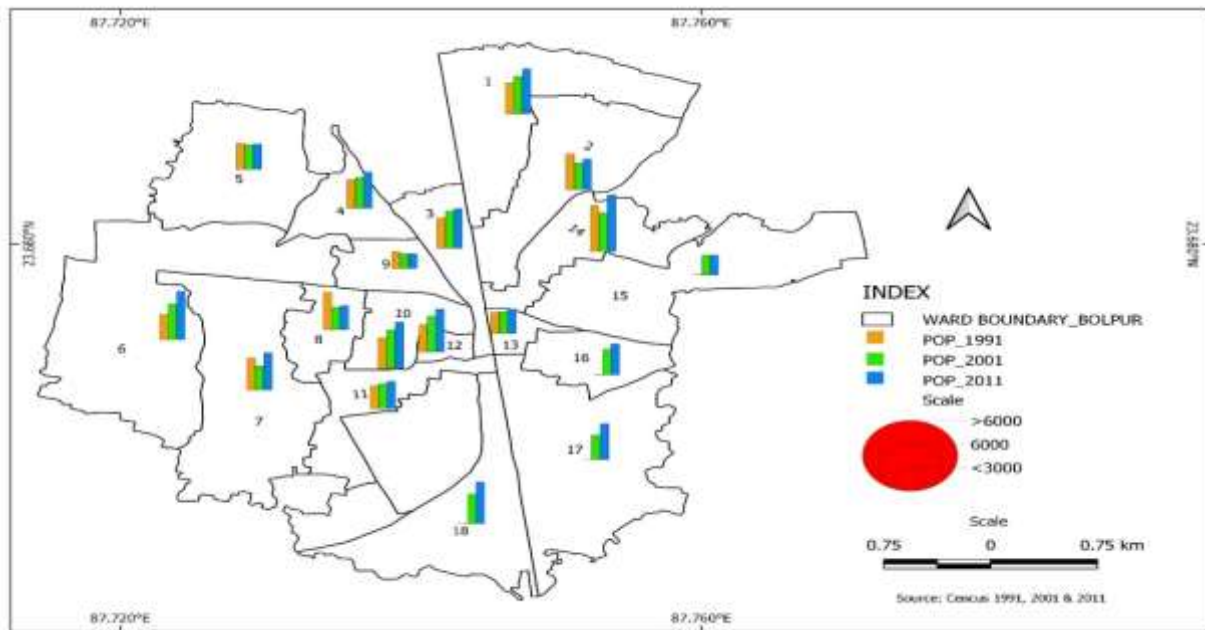
Climatic characteristic features of the Study Area: As per the records of the Sriniketan Weather Station, the Bolpur Municipal area experiences hot (avg. 36°C & max. of 46°C) and dry summer (March to June) with moderately low relative humidity (<50%) and cold (avg. 11°C & lowest- 6°C) and dry winter (end of November to late February) with moderately low relative humidity (40% -50%). It is only during the rainy season (monsoon) when the humidity (90%) increases slowly from late June and decreases again from early October every year. Winter spells caused due to Western Disturbances are also experience by this area during December. Cold weather from about the middle of November to the end of February is followed by summer from March to May. The south west monsoon lasts from June to September, October and the first half of November makeup the post monsoon months of June to September is about 78 % of the annual rainfall. the rainfall in the Bolpur in general decreases from the north west towards the south west. Temperature begins to rise rapidly from about the

beginning of March. May is the hottest month with the mean daily maximum temperature of 39.7°C and the mean daily minimum of 26.3°C (Appendix- 5).

Natural Vegetation in Bolpur Town(M) and surrounding areas:

Bolpur as a whole belongs to the tropical dry deciduous and tropical mixed type with a few representatives of the ever greens occurring here and there. The common local trees are sal, mahogany, mango, coconut tree, guava tree, Sonajhuri tree, palm, arjun, jack, mahua, kend, neem trees etc.

Demographic Characteristics: The following charts and diagrams show the glimpses of demographic structure of Bolpur Municipal area. From the census data of the Bolpur town it has been found that the population is steadily increasing in Bolpur Municipal area since 1951 and this is because of the incorporation of more and more adjacent panchayat areas from time to time. Besides, the continuous socio-economic and urban infrastructural development during the last three decades also are attracting more and more population to this town.



1. Makrampur
2. Trishulapati
3. Mission Compound
4. Bhubandanga
5. Bhubandanga & Gurupally
6. Jambuni, Kalimohanpally and Udayanpally
7. Bandhgora & Nichu Bandhgora
8. Rabindrapally, Natunpukur and Natunpally
9. School Bagan & Collegepally
10. Debenfranj (South)
11. Vivekanandapally
12. Hat-tala
13. Dangali Kalitala & Ukilpatty
14. Kalikapur & Saradapally
15. Nichupati, Vidyasagarpally & Annapurnapally
16. Anandapally & Nayekpara
17. Dharmaraj-tala & Suripara
18. Kacharipati & Kasimbazar.

fig. 5: Wardwise distribution of population during 1991, 2001 and 2011.

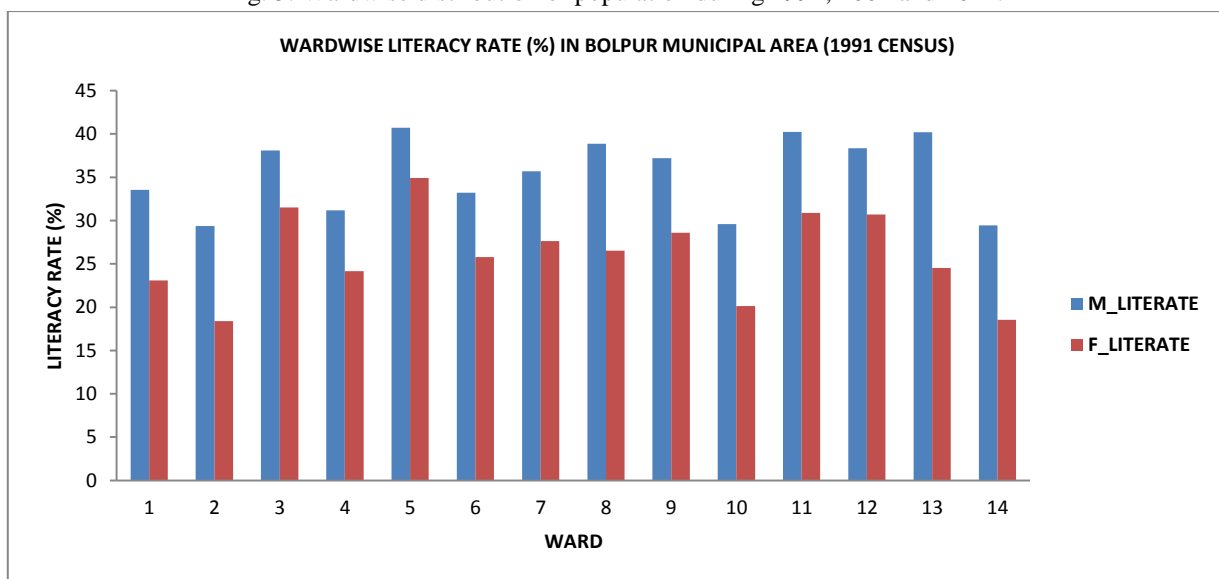


fig. 6: Wardwise density of population/ km² in 1991

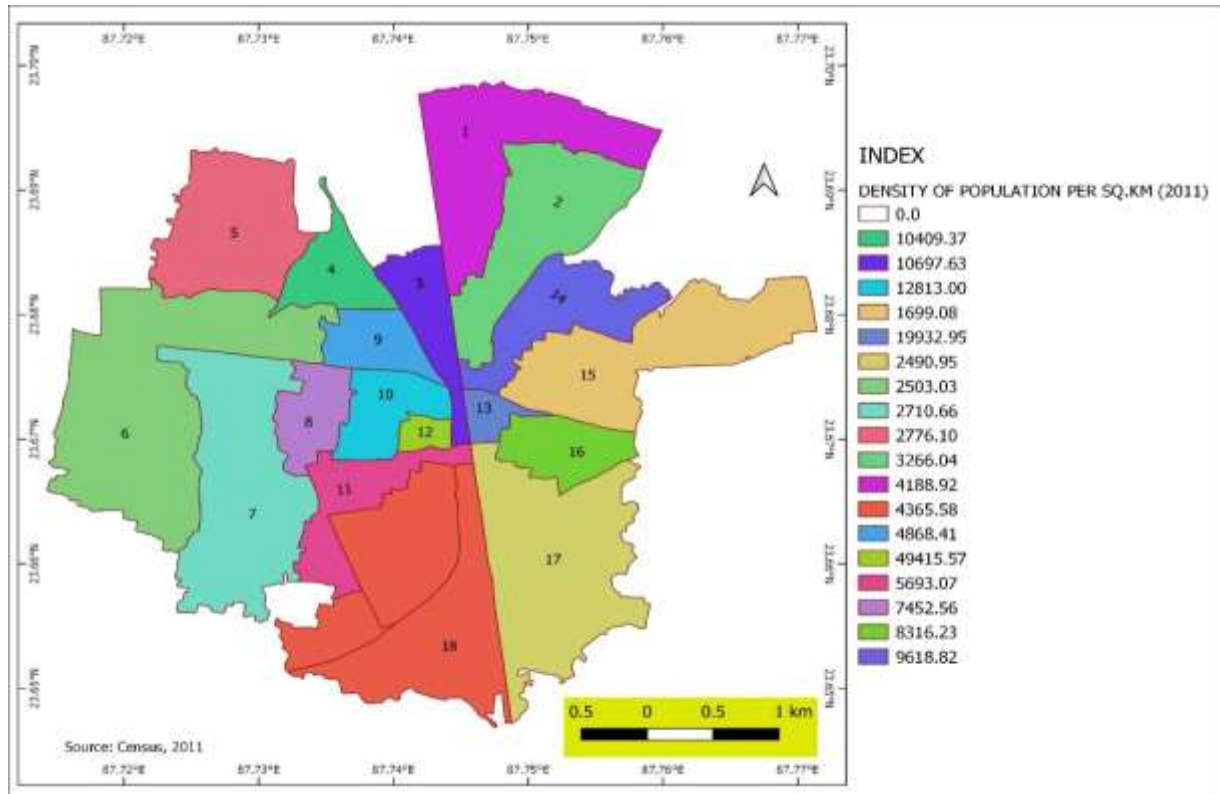


fig. 7: Wardwise density of population/km² in 2011.

Table 1: Wardwise total number of Male-Female Working Population in 1991, 2001 & 2011

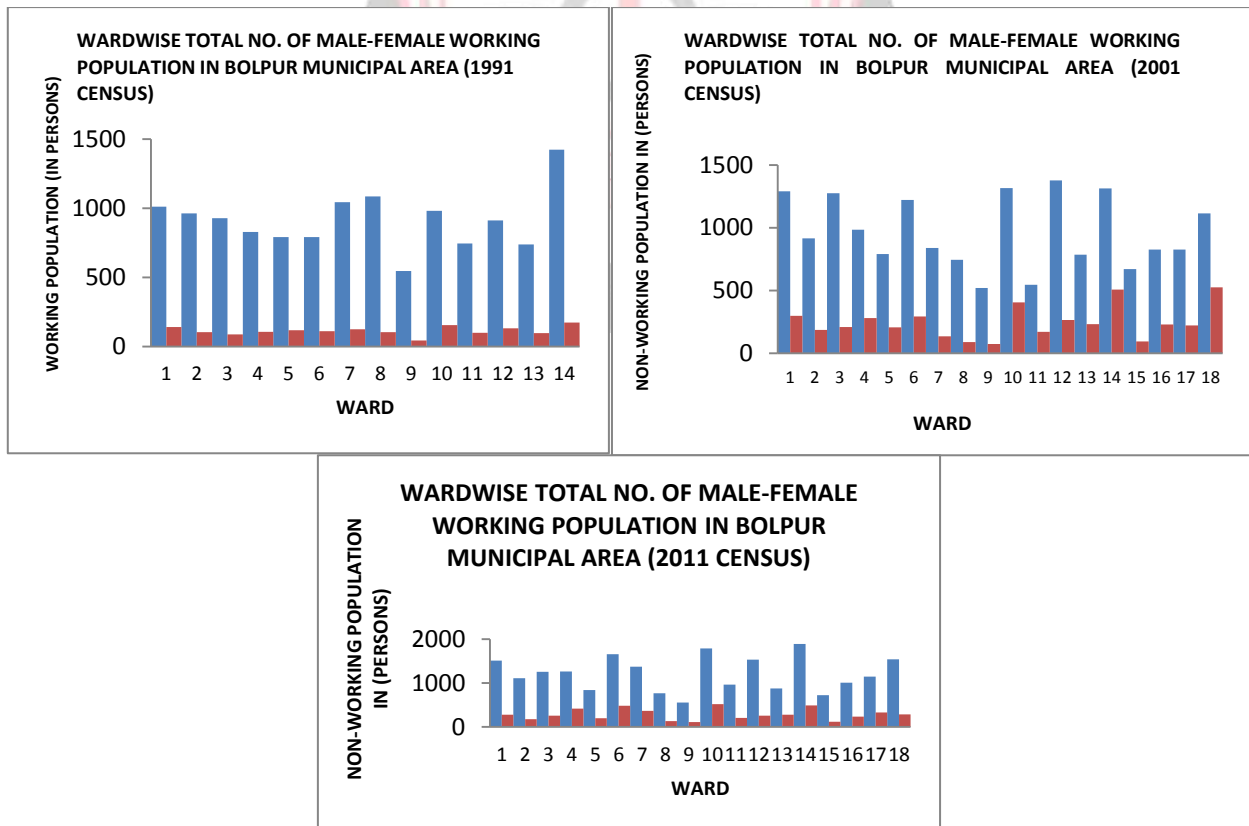


Table 2: Wardwise total number of Male-Female Non-Working Population in 1991, 2001 & 2011

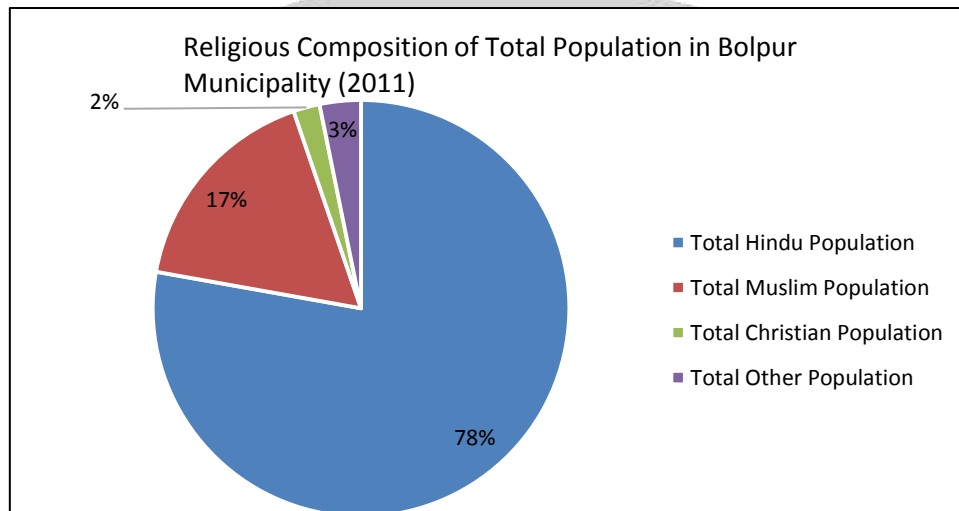
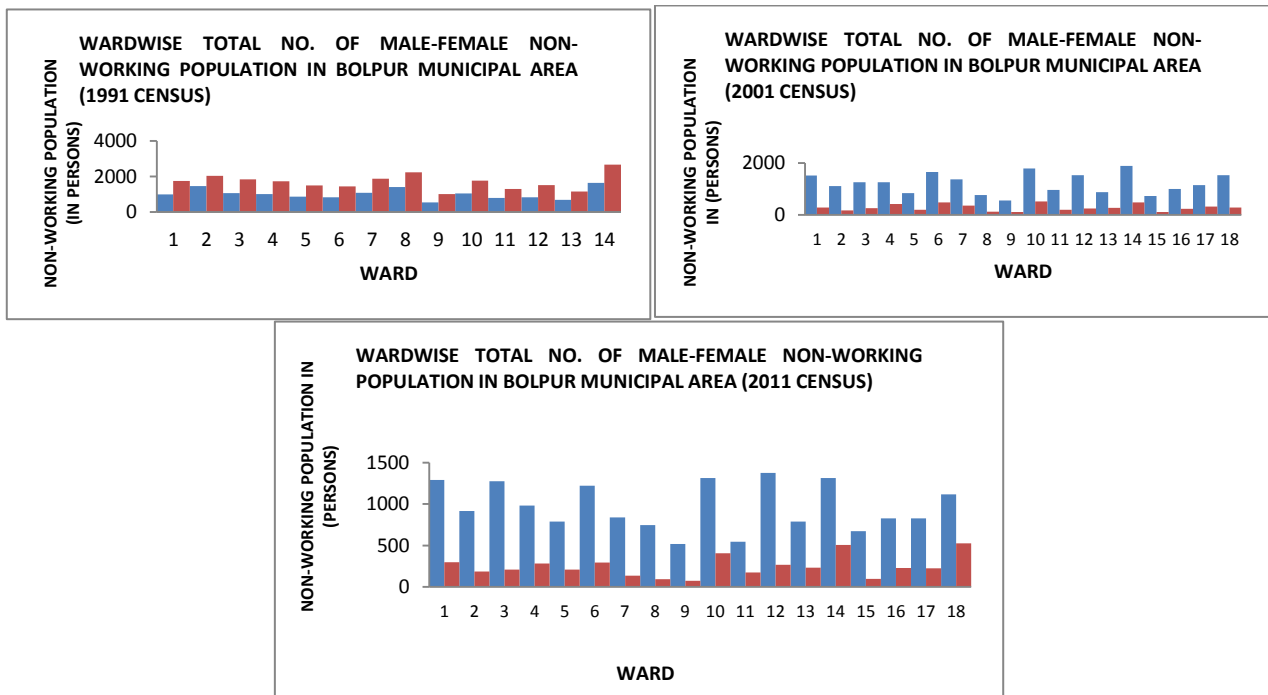


fig. 8: Socio-Economic Status of Bolpur Municipal area, 2011

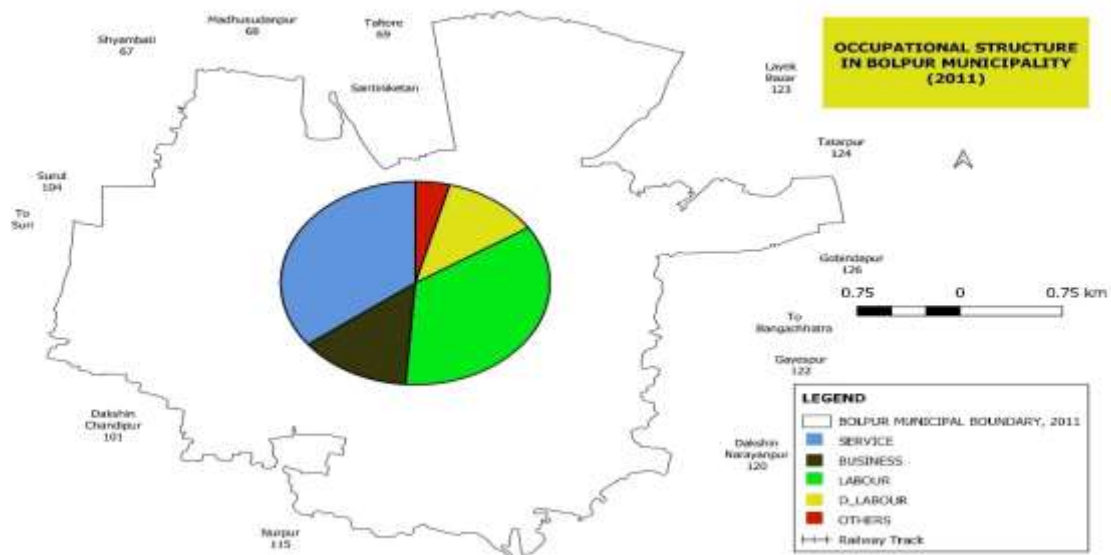
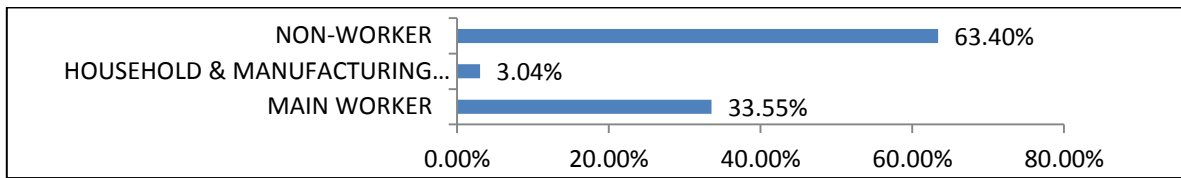


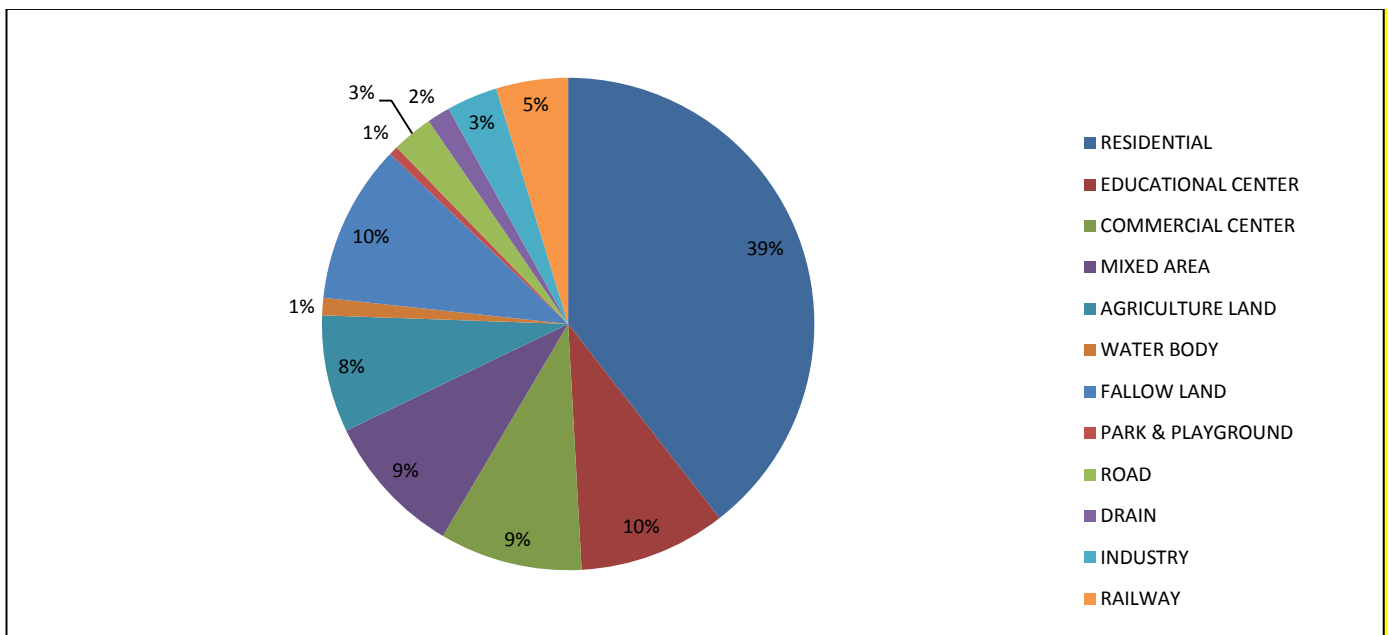
fig. 9a: Occupational Structure of Bolpur Municipality, 2011



Source: Draft Development Plan Bolpur Municipality, 2011

fig. 9b: Occupational Structure of Bolpur Municipality in 2011 (Appendix-3)

Land use and Land Cover of Bolpur Municipality: Due to the Rarh environment and having a lateritic soil environment, the land use of Bolpur Municipality doesn't get varieties of land use facilities. Hence, only the flat areas with loamy soils in the adjacent panchayat areas are arable and are used for agricultural purposes. Almost 39% of the total land area of Bolpur Municipality was used for residential purposes (fig. 2b & 10) and about 10% area was under park and playground, 9% under roads etc. Only 5% of the total municipal area was under waterbody which is too small for supplying adequate water supply for multipurpose uses (exclusive drinking purpose). This municipal town has an area under high and low drains which are not capable of draining out the household liquid waste-waste water and drain-water overflows on the roads during heavy shower in monsoon.



Source: SSSA, Bolpur-Sriniketan Block, Birbhum, W.B. 2011

Fig 10: LULC of Bolpur Municipal area (2011)

Civic amenities: Bolpur, like all other Municipality of West Bengal enjoys an average quality of urban civic amenities like potable water supply, weekly manual draining out of household and roadside wastewater through kuccha, pucca low or high drains, provides sufficient and uninterrupted electric supply, streetlight facilities during darkness, cleaning of roads and weekly collection of household and market area garbage and provide adequate and hassle-free hospital facilities. The Sub-Divisional Hospital near Sian, the Bolpur Town Hospital and Primary Health Centre work day and night. Concrete roads as well as metaled roads interconnecting the wards has been constructed from time to time but the slope of the roads and their heights are often found below the high/low drain level.

Water Supply Management in Bolpur Municipality (Since 1991 to 2011):

1991: The total requirement of water (including drinking and other miscellaneous purposes) in 1991 was 3,68362.15 lakh gallons of water per day i.e. 0.368 million gallons whereas, the total supply of water in Bolpur-Sriniketan Block was 2.56 lakh gallon per day i.e. 0.256million gallon per day (as per PHE Department of Bolpur Municipality).

2001: The total requirement of water (including drinking and other miscellaneous purposes) in 2001 was 4,65980.71 lakh gallon of water per day i.e. 0.466 million gallons whereas, the total supply of water in Bolpur-Sriniketan Block was 19.06 lakh gallon per day i.e. 0.19 million gallons per day (as per SSSA, 1997).

2019: The total requirement of water (including drinking and other miscellaneous purposes) in 2019 is 5,95264.77 lakh gallons of water per day (projected) i.e. 0.595 million gallons whereas, the total supply of water in Bolpur-Sriniketan Block was 954666.538 lakh gallon per day i.e. 0.955 million gallons per day (as per PHE Department of Bolpur Municipality).

A detailed calculation of probable water demand has been done on the basis of total population of the census years 1991, 2001 and 2011 assuming a minimum demand of 17 liter of water/day for the children <6 years of age and persons >6 years of age with a daily water demand of 28.5 liter/day. Likewise, the amount of municipal water supplied by the PHE department of the Bolpur Municipality was also calculated to justify whether the demand exceeded the supply of water and vice versa. It was found that the result of the calculation shows that during 1991-2001, there was a edgrowth of water supply of during 1991-2001 in Bolpur Municipality which was about 0.27%. The growth rate of water supply started increasing from 2001-2011 (up to 2019) in Bolpur Municipality which is about 4.0%. The first proposal (German water project) was made in 1998 and was implemented in 2002. When the project was implemented in 2002, 1.90 MGD water was taken out but subsequently 4 MGD water was taken up due to population growth. The water which is extracted from the German project is mixed with chlorine to clear the water, which is supplied to the municipality and the municipality distributes the water ward-wise. There are seven water tanks in Bolpur out of which 5(five) are currently active and 2(two) are still in progress.

Table 4: Calculation of the water demand of the inhabitants of Bolpur Municipal Town in 1991, 2001 and 2011.

Population (below 6 years)			Population (above 6 years)			Total Demand by Total Population (in gallon), 1991
	Amount in litre	Amount in gallon		Amount in litre	Amount in gallon	
Drinking Water Demand	2	0.52	Drinking Water Demand	3.5	0.91	
Misc. demand (bathing, washing clothes, sanitation etc.)	15	3.9	Misc. demand (bathing, washing clothes, sanitation etc.)	25	6.5	
Total	17	4.42	Total	28.5	7.41	
for 7555 children in gallon per day	128435	33393.1	for 45205 people in gallon per day	1288342.5	334969.05	
Yearly consumption in gallon	46878775	12188481.5	Yearly consumption in gallon	470245012.5	122263703.3	13,44,52,184.8

Population (below 6 years)			Population (above 6 years)			Total Demand by Total Population (in gallon), 2001
	Amount in litre	Amount in gallon		Amount in litre	Amount in gallon	
Drinking Water Demand	2	0.52	Drinking Water Demand	3.5	0.91	
Misc. demand (bathing, washing clothes, sanitation etc.)	15	3.9	Misc. demand (bathing, washing clothes, sanitation etc.)	25	6.5	
Total	17	4.42	Total	28.5	7.41	
for 6958 children in gallon per day	118286	30754.36	for 58735 people in gallon per day	1673947.5	435226.35	
Yearly consumption in gallon	43174390	11225341.4	Yearly consumption in gallon	610990837.5	158857617.8	170082959.2

Population (below 18 years)			Population (above 18 years)			Total Demand by Total Population (in gallon), 2011
	Amount in litre	Amount in gallon		Amount in litre	Amount in gallon	
Drinking Water Demand	2	0.52	Drinking Water Demand	3.5	0.91	
Misc. demand (bathing, washing clothes, sanitation etc.)	15	3.9	Misc. demand (bathing, washing clothes, sanitation etc.)	25	6.5	
Total	17	4.42	Total	28.5	7.41	
for 6852 children in gallon per day	116484	30285.84	for 73358 children in gallon per day	2090703	543582.78	
Yearly consumption in gallon	42516660	11054331.6	Yearly consumption in gallon	763106595	198407714.7	209462046.3

Source: BPH water department

- **Water Holding Capacity in Bolpur Municipality:** The details of the seven water tanks and their water holding capacity is given in table below:

Table 5: Showing the water holding capacity of the water-tanks in Bolpur Municipality, Birbhum.

Active or under construction	Sl. No.	Location	Ward Name	Ward NO.	Water Holding Capacity (M ³)
Active	1.	Makrampur	Bagan Para	1	600 M ³
	2.	Gyanananda Ashrama	Jambuni	6	1450 M ³ (Biggest)
	3.	School Bagan	School Bagan	9	400 M ³
	4.	Circuit House	Jambuni	6	720 M ³
	5.	Nichupati	Nichupati	16	720 M ³
Under construction	6.	Bypass	Jambuni	6	100 M ³ (smallest)
	7.	Udayanpally (Back side of bus stand)	Udayanpally	6	350 M ³

Table 6: Timing of Water-lifting (Daily)

Morning	Noon	Afternoon
6.30 AM – 8 AM	12 PM – 1 PM	4.00 PM – 5.30 PM

Source: PHE Department, Bolpur Municipality, Birbhum, W.B., 2011

About 4 Million Gallon/per day water has being supplied ward-wise daily by Bolpur Municipality since 2011. There were total of 480 stand posts and 592 Hand-Tube well and 23 Tube well in all over 18 wards, but now (in 2019), there are 480 stand posts and 592 hand tube wells. It plans to increase the number of tube wells in 2035. The location of the Deep Tube wells and their capacity are given in the table below:

Table 7: Deep Tube Well (DTW) location and holding capacity, 2011 onwards

Sl. No.	Location	Holding Capacity (M ³ / Hour)
1.	Udayanpally	110 M ³ /Hour
2.	Dukbungalow	16 M ³ /Hour
3.	Jagarani club	80 M ³ /Hour
4.	Rabindrabhati Bypass (near OHR)	63 M ³ /Hour
5.	Makrampur	63 M ³ /Hour
6.	P—9	76.5 M ³ /Hour
7.	IT—4	110 M ³ /Hour
8.	Nichupati (OHR)	126 M ³ /Hour

Source: PHE Department, Bolpur Municipality, Birbhum, 2019.

About 19 (earlier-14 and later-5) high lifting pumping stations are present to supply water in 20 wards at present (2019). The depth of 19 High Lifting Pumping Station are 1400ft. – 1600ft. and 90 litres of water is allotted daily for each person. In the summer, when water problem occurs, the pumps run for 20—22 hours instead of 17 hours. The main source of the Indo-German water is ground water table below the municipal town. Out of the total supplied water to the municipality, about 20%-25% of water is wasted daily either by miscellaneous uses or naturally to some extent through evaporation and evapotranspiration. To solve this water problem, the total 40 projects have been adopted till now by Indo-German water project in entire Birbhum.

Reasons behind scarcity of drinking water during dry seasons in recent years:

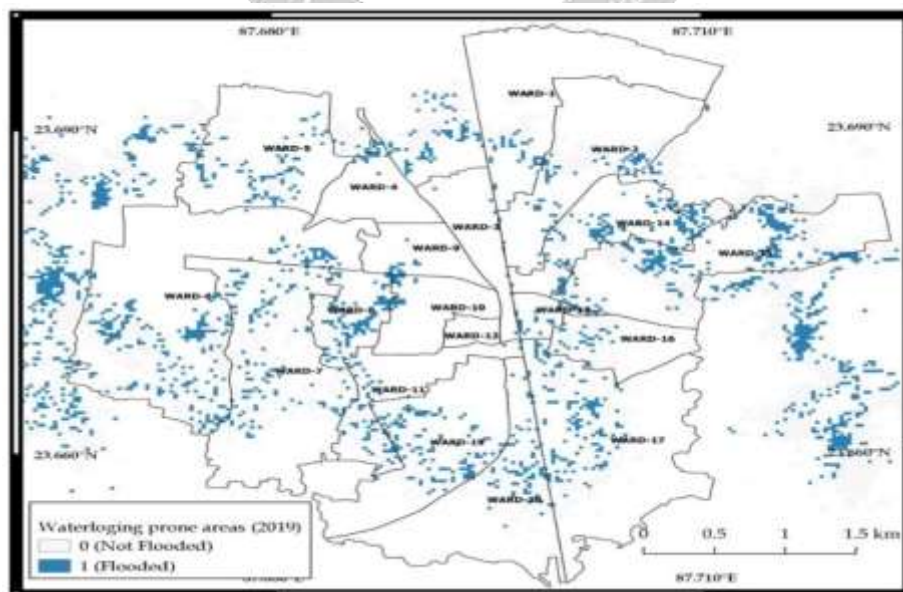
1. Increase in water consumption by commercial sectors like market shops, groceries, vendors and other tertiary service sectors like- schools, colleges, banks, court, construction related working sectors, railway complex, bus terminus, theatres, hotels/lodges/guest houses, post offices, health centre and etc.
2. The major annual festivals like Poush Fair and Vasanta Utsava at Santiniketan also consume huge amount of municipal water during last week of December and 1st or 2nd weeks of March.
3. Major portion of the water supplied municipality and uplifted through submersible pumps are used in building construction purposes particularly by the shopping malls which have rapidly grown in numbers now a day. The over harnessing of the ground water is also responsible for lowering of ground water level as ward-wise maximum private household boring reports revealed the facts that the ground water level below has been sarcastically declined to more than 280 feet now a day which was only 140 feet during 1991 in some wards.

Waterlogging in Bolpur Municipal area: During the field survey a detailed slope measurement was done along with the GPS and Slope Map of Bolpur Municipal area. It was found that the Bolpur the elevation of Bolpur Municipal area ranges between 40m-60m above MSL. The following table Deep tube well location and holding capacity, 2011 onwards Table: Showing different elevation zones of Bolpur Municipality, 2019

But during the survey it was very much clear that the roads connecting different wards are of different width and made up of different materials. The drains are being constructed now days in growing households in different wards by the municipality. Often in some wards it was found that the newly constructed drains (both high and narrow) lie above the roads. The Wards numbering Ward-1 (western half), Ward-2 (south-western part), Ward-3 (northern part) and Ward-4 (eastern part) has an average elevation of 58m above MSL (Fig. 3 & Table 1).

Areas in different wards facing frequent waterlogging conditions during last three census decades (1991-2011) in Bolpur Municipal area –

Jambuni Bus Stand area in Ward No. 6, Bhubandanga Handicrafts Market area in Ward No. 4 & 5,



Source:DEM, 2010

fig. 11: Waterlogging prone zones of Bolpur Municipality of Birbhum District

West Gurupally in Ward No. 5, Indirapally in Ward No. 5, Bolpur Chowrasta and surroundings in Ward No. 3, Chitra Cinema Hall more in School Bagan area in Ward No.-9, Suripara in Ward No. 20, Nichupati in Ward No. 15.

IV. FACTORS BEHIND WATERLOGGING

(a) Natural factors: The natural factors working behind the frequent waterlogging conditions in Bolpur Municipality are as following –

- (i) The geological undulating structure and the lithological character are responsible for the waterlogging conditions in shallow areas of Bolpur Municipal area.
- (ii) Uneven rainfall and sudden heavy shower is also responsible for waterlogging conditions in this area.

(b) Anthropogenic factors: The factors working behind the frequent waterlogging conditions in Bolpur Municipality are as following –

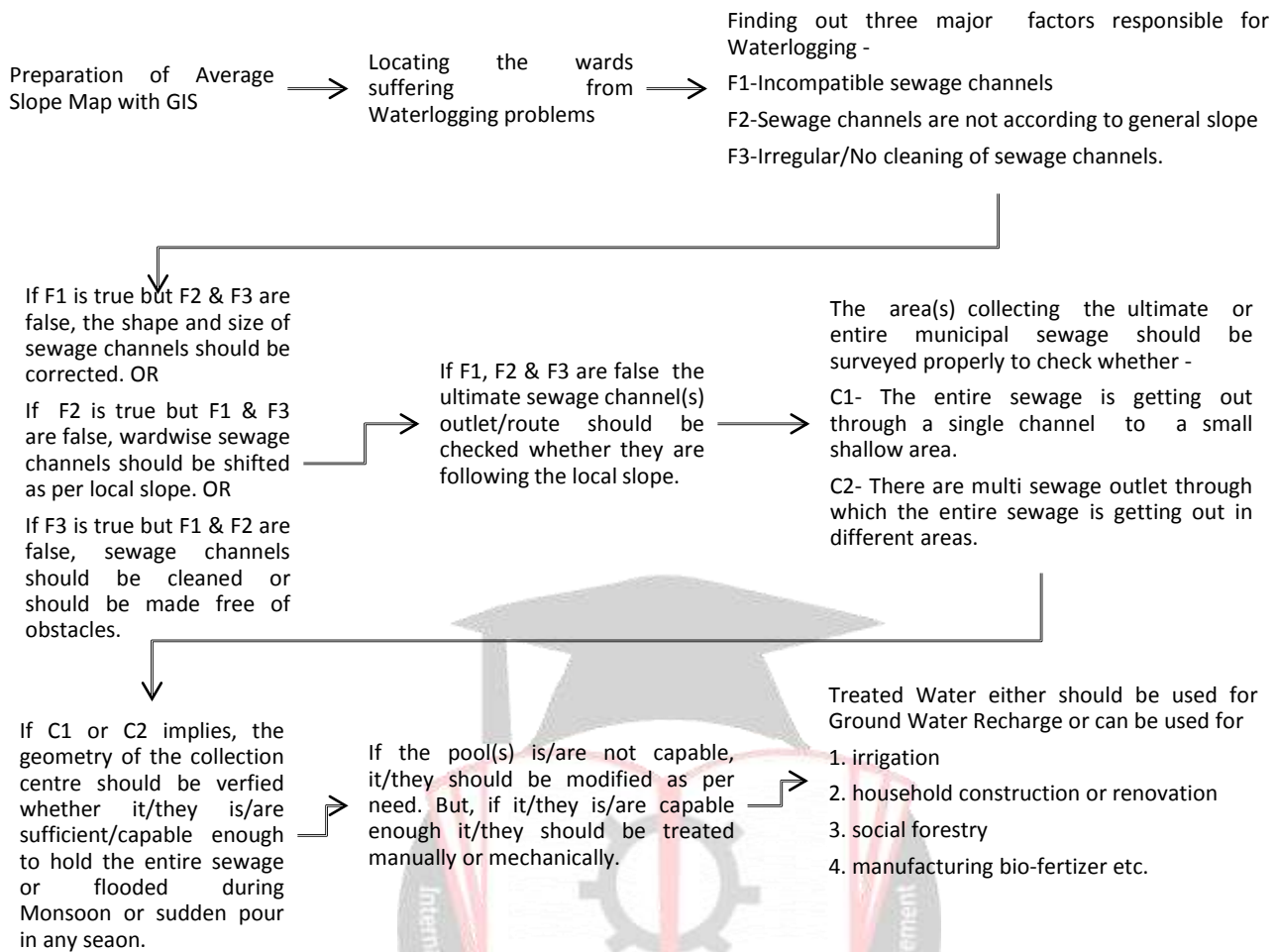
- (i) Road construction is not followed by the contour height in this area.
- (ii) Drains are not constructed following the contour height.
- (iii) Dumping of construction materials along the roadsides do not allow the surface runoff properly.
- (iv) Choking of the outlets of the drains by household, market and construction materials are very common factor for improper draining out of the rain water.
- (v) In most of the wards, the newly built houses doesn't leave sufficient space (as per municipal rules and regulations laid by the Govt. of W.B. for interlinking sewage water system to solve the ward-wise drainage problem.
- (vi) Tourists also throw garbage or plastic packets during festival seasons in Santiniketan which results in mass choking of the uncovered high drains also. This blockage of normal sewage water draining out abnormal and often are responsible in waterlogging conditions when overflowed during a little and short spell anytime.

V. MAJOR FINDINGS

Field report on the STATUS OF WATER SUPPLY MANAGEMENT AND DRAINAGE PROBLEM MITIGATION IN BOLPUR TOWN has found the following findings –

- (i) The typical climatic and lateritic topographic character of the municipal area is responsible for the seasonal scarcity of water during dry seasons.
- (ii) With the increasing population the numbers of households are also increasing rapidly in this town since 2001. Thus, the major portion of the municipal supplied water is indirectly used by the small houses, large housing complexes and shopping mall construction purposes which ultimately are lowering the ground water-level and decreasing the availability of drinking water during dry seasons which nullifies the first statement of the hypothesis (H_0)
- (iii) The growth of the urban area and incorporation of more and more panchayat areas into municipal area is also bringing the risk of more water demand.
- (iv) The water scarcity reaches its apex during the Vasanta Utsava in the month of march and the during the Pous Fair in December which nullifies the first statement of the hypothesis (H_0) also.
- (v) Increasing number of tourists and local visitors are creating pressure on the present water supply here which nullifies the first statement of the hypothesis (H_0)
- (vi) The unscientific construction of roads and improper management of sewage of household or industrial waste water through the incompatible and lesser amount of deep municipal drains are also causing sudden waterlogging conditions in this town which accepts the second statement of the hypothesis (H_1) and rejects the first statement.
- (vii) The leveling of the drains according to the contour height of different wards also are responsible for waterlogging during a little spell.
- (viii) Recently, the Municipality is working with so many projects which have reduced the waterlogging areas in this town.
- (ix) There is need for detailed topographic and hydro-morphological survey to mitigate this problem. The proposed system of draining gout the water from waterlogged area may reduce the problem to some extent and that waste water may be recycled or reused for different activities by storing them in low lying areas outside the municipal areas. That drained out water collected from the waterlogged area may help the agricultural activities outside this municipal area in dry seasons.

DESIGN FOR MITIGATING WATERLOGGING PROBLEMS IN BOLPUR MUNICIPAL AREA



VI. CONCLUSION

The above field report reveals the facts that any internationally and nationally important tourism-centric rapidly growing municipal area like Bolpur, must have a well-organized urban water-management system to fulfill the standard requirement of drinking water for overall future socio-economic-cultural development. From this point of view, there is more attention required in this issue as the number of housing estates, complexes, resorts, hotels and homestays is increasing rapidly with least concern over the ground-water storage of the future capacity to serve the people of Bolpur during hot dry seasons or during festivals. On the other hand, the frequent waterlogging problems must be mitigated with updated machineries and more geographic knowledges must be implied during draining out of the sewage and surface runoff particularly during monsoon spells. Otherwise, this may lead to future socio-economic hurdles and increase in sanitation and hygiene related issues in near future.

ACKNOWLEDGEMENT

Any field work or report doesn't become successful without the help, assistance and guidance of the persons who directly or indirectly help the surveyor or reporter. It will be noteworthy to thank those contributors from the core of my heart who helped me to complete this report. First of all, we would like to pay my dedicated gratitude to our teacher cum supervisor Dr. Jayanta Gour, Assistant Prof. in Geography of our Department of Geography for his guidance. To the next, we thank all the officials of Bolpur Municipality, Birbhum District for supplying all sorts of official data to furnish this report. Secondly, we are grateful to our Principal-sir, Dr. N.N. Chakrovorty, for providing us all kinds of official facilities to obtain the different official level data from the Bolpur Municipality Office and from other govt. offices also. We pay our gratitude to the Librarian, Ms. H. Mondal, and to Sri H. Sarkar, Deputy Director, Bureau of Applied Economics and Statistics, Department of Planning and Statistics, Birbhum District, Suri, Govt. of West Bengal, for providing us all sorts of census data and allied municipal data without getting which it was quite impossible to prepare this project.

Last but not the least, we, solemnly thank to those persons of different wards of Bolpur Municipality who gave us their valuable time for us and gave their support to carry on this report successfully.

Appendix-1 Master Sheet of Bolpur Municipality at a glance

SL. NO	GENERAL INFORMATION		DESCRIPTION
1	Name of the Municipal Town		Bolpur
2	Head Quarter (HQ)		Suri
3	Block, Sub-Division		Bolpur, Bolpur-Sriniketan
4	Name of District		Birbhum
5	Name of the Sub-division		Bolpur
6	ZIP		731204
7	Assembly Constituency, Lok Sabha		286 Bolpur, 41Bolpur(SC)
8	Coordinates		23.67° N & 87.72° E
9	Time Zone		UTC +5.30 IST
10	Total Area (as on 2011)		13.13 km ² (5.07mile ²)
11	Temperature		26.3°C (Average)
12	Precipitation		1287mm(Average)
13	ISO 3166 code		IN-WB
14	Station code		BHP & PNE
15	Average Elevation (above MSL)		58m (190 ft)
16	Language		Bengali, Hindi, English
17	Total Area		13.13sq.km.
18	Total Residential Area		5.18sq.km.
19	Total Agricultural Area		1.01sq.km.
20	Total Commercial Mixed Area		2.46sq.km.
21	Total Other Area		4.48sq.km.
22	No. of Wards (as on 2013)		18
23	Total Population (as on 2011)		80210
24	Density of Population		6190 person/sq.km.
25	Sex Ratio		982
26	Total Hindu Population		62410 persons (89.77%)
27	Total Muslim Population		13592 persons (9.68%)
28	Total Christian Population		1642 persons (0.19%)
29	Total Other Population		2566 persons (0.36%)
30	Total Slum Colonies		25
31	Total Slum Population		24571 persons
32	Total Workers (as on 2011)		29354 persons
33	Total Non-Workers		50856 persons
34	Transport & Communication		Bus, train, taxi, auto, mini-van, rickshaw, tumtum, private vehicle, truck, pick-up van etc.
35	Highway	National Highway(NH)	2B(Bardhaman-Bolpur), 2B Ext Mallarpur NH-60 JN at Mallarpur.
		State Highway(SH)	SH-14(Illambazar-Bolpur), SH-13(Mallarpur).
		District Highway(PWDsR)	Bolpur -Purandarpur Road, Bolpur -Gunutia Road, Bolpur- Nanoor - Kirmahar Road
		Others Road	Wards are communicated by Municipal and PWD road
36	Trade & Commerce		Small industries, Rice-mill, Flour and Oil mill, Bakery, Confectionery, Saw-mill, Hardware shops (construction), Stationary shops, Hotels, Restaurants, Guest-House and Lodges, Press (Printing), Fruit and Vegetable Market, Fish-Market, Cottage Industries, Cold-storage etc.
37	Nearest Rail Station		Bolpur-Santiniketan Rail Station(BPH) & Prantik Rail Station (PNE).
38	Nearest Bus-stand		Bolpur Jambuni Bus-stand
39	Name of the nearest river(s)		Ajay Nad & Kopai Nadi
40	Educational Institution	University	Visva-Bharati University (central), Seacom Skills University (private),
		College	Bolpur College (under Burdwan University), Purnidevi Chowdhury Girls' College (Burdwan University)
		School	Bolpur High School, Bandhgora Kali Krishna High School, Bolpur N.N.B. High School, Bolpur Girls High School, B.S. High School, Tarashankar Vidyapith, Parul Danga High School, Parualdanga High School, Bolpur Central School, Vivekananda Vidyapith etc.

	Diploma Course's institution	Santiniketan Institution of Polytechnique. (SIP) Bengal Institution of Technical Management(BITM), BIRD, NABARD etc.
	Others Private School	Ryan International School, St. School, Techno India Group Public School (TIGPS), Nava Nalanda High School (Santiniketan), Kisholoy, EMRS, IGNOU etc.
	Library	library: VU Central library, Bolpur Town library, Bolpur Sadharon Pathaghar etc.

Source: Bolpur Municipality Office database, 2019-20

Appendix-2 Small Industries / Commercial Establishments in Bolpur Municipality, 2011

Types of Industries	Number	Employee engaged (persons)
Rice mill	6	630
Flour and Oil mill	12	70
Bakery	2	25
Confectionery	60	200
Coal shop	4	12
Saw mill	7	82
Servicing (misc.)	80	270
Sheet metal (misc.)	5	68
Footwear	12	40
Washing shop (misc.)	8	25
Construction (misc.)	15	80
Printing Press	10	50
Hotel	30	630
Stationary	350	730
Cottage	140	720

Source: Draft of Development Plan for Bolpur Municipality, 2011

Appendix-3 Occupational structure:

Occupational Details	Person	Percentage%
Total Main Worker	26915	33.55
Total Household & Manufacturing Worker	2439	3.04
Total Non-Worker	50856	63.40

Source: Census 2011

Appendix-4

SI No	Scheme Executed	2017-18	2018-19	Remarks
1	Roads-Number & K.M.S	C.C. Roa33nos-13.8km B.T. Road17nos-8.9km	C.C. Road 46nos-11.5km B.T. Road 2nos-1.5km	-
2	Street Lights	1500nos	2500nos	-
3	Beautification of Park	3 Number	2 Number	-
4	Drain	60number-Length-10.3km	42number-Length-5.9km	-
5	Toilet	390	1240	155in Progress
6	Places of Solid/Liquid Waste Management	Khoskadampur (5 Km from Bolpur) Sian Gram Panchayat	Khoskadampur (5km From Bolpur) Sian Gram Panchayat	-
7	Plantation	1200	-	-
8	Pond-Excavation & Maintenance	Nil	Nil	-

Source: Office of the Bolpur Municipality

Appendix-5

	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
Avg. Temperature (°C)	19	21.5	26.9	30.8	30.7	30.7	28.9	28.8	28.8	27.3	23	19.6

Min. Temperature (°C)	12	14.4	19.4	23.7	25.5	26.2	25.7	25.7	25.4	23	17	12.9
Max. Temperature (°C)	26	28.6	34.4	38	35.9	35.2	32.2	32	32.3	31.7	29.1	26.3
Precipitation / Rainfall (mm)	12	21	24	41	88	239	295	275	170	105	12	5

Source: Meteorological Department, Sriniketan, 2019

Appendix-6

Sl No.	Land Use Details	Bolpur	
		Area in Use	Percentage%
	Ward Boundary	13.13	-
1	Residential	5.18	39.45
2	Educational Centre	1.27	9.67
3	Commercial Centre	1.23	9.37
4	Mixed Area	1.23	9.37
5	Agricultural Land	1.01	7.69
6	Water Body	0.15	1.14
7	Vacant Land	1.37	10.43
8	Park & Play Ground	0.08	0.61
9	Road	0.35	2.67
10	Drain	0.2	1.52
11	Industry	0.44	3.35
12	Railway	0.62	4.72
	Total	13.13	100

Source: SSDA & Bolpur Municipality Data

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