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Redevelopment of The Walled City of Delhi: An Assessment of the Planning Framework and Governance Challenges

Aisharya Bhattacharjee*

Abstract : *In the present day, city revitalization has become one of the prime elements in urban studies. However, a multitude of approaches are embedded in the term "city revitalization" like redevelopment, rehabilitation and conservation. In line with this concept, a case study of the revitalization of the walled city of Delhi from the perspective of redevelopment has been undertaken in this research work that specifically attempts to portray the myriad of transformations contingent upon the redevelopment work of the city in progress. At the same time, it also tries to delve meticulously into the planning framework of the city and the associated governance challenges faced in the process of redevelopment.*

Keywords : *Governance, Planning, Redevelopment, Walled city*

Introduction

With the shift of the contemporary paradigm to a more ecological one, city beautification have become the tagline of most of the master plans that are being framed for the metropolitan cities. In context of these, urban renewal and redevelopment in the form of decongesting the city core, demolition and resettlement of slums and squatters, infrastructural upgradation and the like has become the primary target for agencies involved in such revitalization projects. There are numerous instances in the developing world where people have gradually relocated from the congested city core to the surrounding areas. Big old homes have been divided into apartments or used for non-residential purposes while smaller houses have been sold or leased fairly cheaply and, in the scramble for cheap accommodation, have inevitably suffered from overcrowding (Hoff and Duggar 1959). All these necessarily bring the discourse on city revitalization as one of the prime elements in urban studies.

A myriad of definitions have been given in the context of urban renewal by different scholars. Urban renewal is a part of a larger process, by which the human environment is continually transformed and social capital is accumulated in urban areas and other settled areas (Hoff and Duggar 1959). According to Groberg (1965) urban renewal encompasses all public and private efforts to improve city form and life. Onkar, Dhote and Sharma (2008) is of the opinion that urban

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renewal and redevelopment strategies have gradually evolved into a policy which is based less on the destruction and more on the renovation and investment, and at present, it is a significant part of numerous local governments, which are often amalgamated into small and big incentives of business. These definitions pristinely reflect the contemporary paradigm shifts in the concept of urban renewal over time.

At this juncture, it is also necessary to delve into the various concepts that are associated with urban renewal. Urban renewal is rather an umbrella term that encompasses in its domain certain sub elements also. Some notable scholars have drawn upon a clear cut division between redevelopment, rehabilitation and conservation associated with urban renewal. (Hoff and Duggar 1959) is of the view that redevelopment should be carried out in those areas where the general layout has become such that there is no further opportunity for any sound economic activity to take place and hence it consists of re-use of the land which is been cleared and generally operates on a project basis. This is somewhat synonymous to the term clearance which will be applicable to those areas which are beyond economical redemption and the only solution is to tear out and rebuild (Wedge 1958). Contrary to this, rehabilitation is considered necessary when some loss of original function is making itself seriously felt; or in which there are conditions that are likely to cause a deterioration of opportunities for sound economic activity or satisfactory living conditions; or in which buildings, though generally in structurally sound condition, have deteriorated because of neglect of maintenance (Hoff and Duggar 1959). It operates through a series of administrative control and correction measures. Rehabilitation is an approach which is commonly used in a run-down area where the homes can be repaired, refurnished, and brought back to the status of good housing (Wedge 1958). On the other hand, conservation is however an entirely in situ concept where the areal aspects are being kept in proper condition through maintenance or restricting the entry of such factors which may cause their deterioration (Hoff and Duggar 1959). Other scholars have approached conservation from a different perspective and have referred it as the treatment applied to the area which is in peril of, but has not yet succumbed to, blight (Wedge 1958).

Some critics have however pointed out to the negative effects of urban renewal and redevelopment. Such problems are intricately associated with the displacement and resettlement of families (Nesbitt 1958) and problem of relating patterns of land use to circulation facilities (Hoff and Duggar 1959). In a research work based on cities in Britain it have been stated that early redevelopment strategies have created significant degrees of spatial fragmentation between functions and the loss of a substantial residential population and hence, in the contemporary social climate, these changes have resulted in negative implications for the perception of safety and the generation of fear and anxiety amongst all users of the city centre (Thomas and Bromley 2000).

Now, converging all these into the present research domain, it is most discernable that for a city like Delhi, where nearly 51.9% of the population is spread over JJ (Jhuggi Jhopri) Clusters, Slum Designated areas, Unauthorized Colonies and Regularized – Unauthorized Colonies, urban revitalization is indeed a herculean task. However, a number of urban renewal projects have been chalked down for the city from time to time that has focused on reshaping the city as well as

conservation of its grandeur architectural heritage. One such evidence may be cited from Shahjahanabad or the Walled City of Delhi which has been cruising through a tangle of deteriorating infrastructure, illegal construction works, dilapidated housing, traffic congestion and a shifting land use to non residential uses. The present research work is therefore oriented to a study of the problems associated with the most densely populated zone of the Delhi and a review of the revitalization work done so far by different agencies, their problems in governance and addressing them.

Aims and Objectives

The research work rests on three main objectives oriented to addressing the research gaps as deduced from the survey of literatures:

1. To analyze as to how the planning framework of the walled city has changed in each of the three master plans i.e. 1961, 2001 and 2021 of Delhi.
2. To understand the governance structure associated with the redevelopment of the area and the consequent impact of redevelopment on the community i.e. people residing there as well as the local traders.

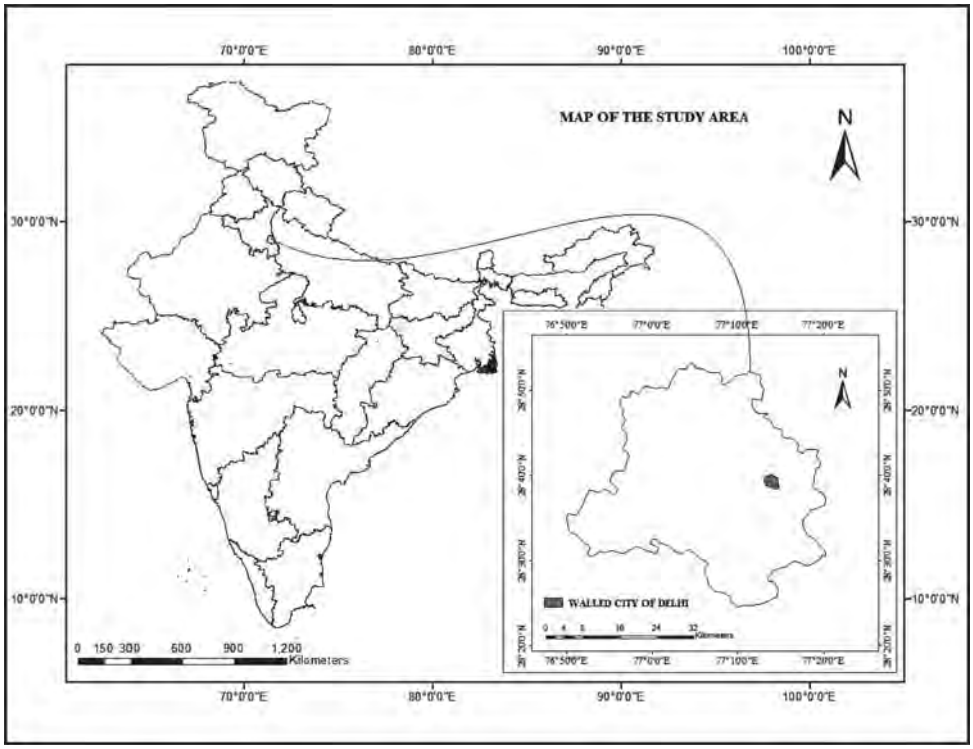

Fig. 1: Location Map

3. To assess the governance issues and challenges associated with the revitalization process.

Database and Research Methodology

The paper is based on both primary and secondary data. A household level perception survey has been conducted in Ballimaran and Lal Kuan area of the walled city of Delhi comprising of 25 households residing in some of the dilapidated havelis found there in order to find out the major issues thronging in the area and therefore the need for revitalization. The respondents were asked to rank the following in order of their preference for the necessity of redevelopment of the area, with 1 given to the indicator that is most crucial for redevelopment as per the perception of the respondents and rank progressively increasing with the higher ones needing the least importance. The indicators so considered are: High residential density; High commercial density; Water issues; Traffic Density, lack of parking space and narrow circulation space; Polluting nature of manufacturing industries; deteriorating heritage fabric; Criminal issues; Lack of sanitation and hygiene and Lack of social infrastructure. In context of the data so collected, a composite score of the ranks assigned has been obtained for each indicator with the least score reflecting the indicator which is in most need for concern.

Secondly, in order to get detailed information about the process in which the redevelopment of the area concerned is being implemented and executed, a short interview has been conducted by the field observer with the various staffs of different agencies involved in the redevelopment process i.e., Shahajanabad Redevelopment Corporation (SRDC), Delhi Development Authority (DDA), Indian National Trust for Art and Cultural Heritage (INTACH) and Delhi Urban Art Commission (DUAC).

Thirdly, a focused group discussion of 6-7 traders each from three katras in Chadni Chowk, namely: Katra Neel, Katra Ashrafi and Katra Nawab regarding the problems they were facing with

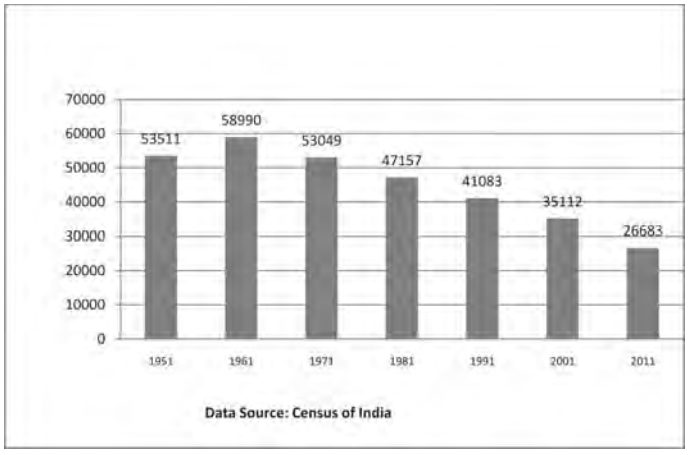

Fig. 2: Population density of Shahajanabad (persons per sq.km)

the revitalization of the Chadni Chowk area in progress and their expectations in business after the redevelopment work is completed.

Secondary data pertaining to the proposals of redevelopment, demographics and land use has been obtained from different sources as in Master Plan of Delhi (MPD), Zonal Development Plans and Census of India.

Delving Into The City Dynamics - Where The Necessity For Planning Lies?

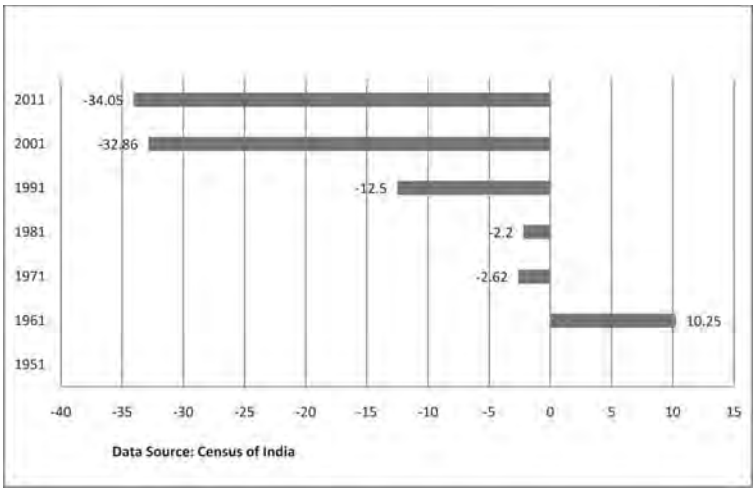

Fig. 3: Population growth rate in Shahajanabad

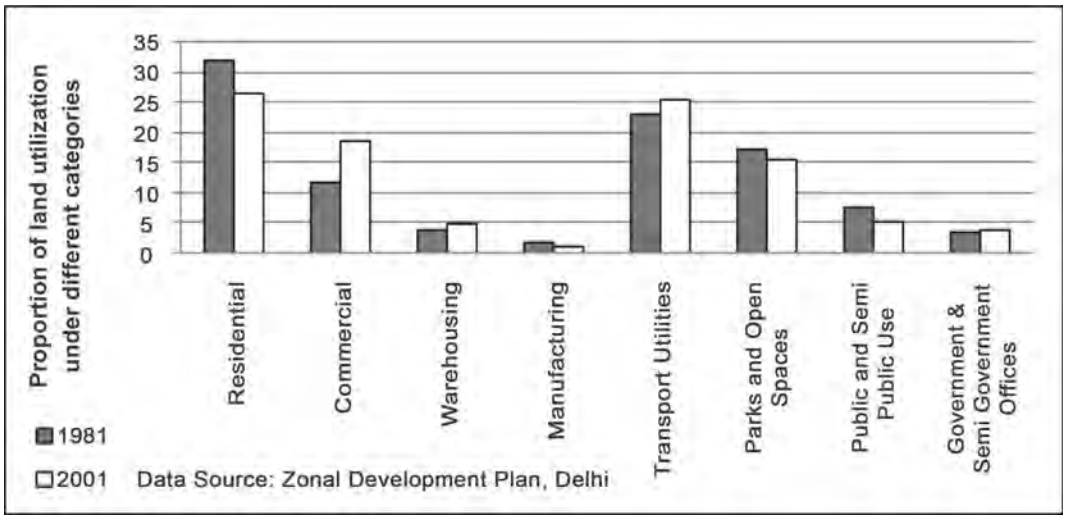

Fig. 4: Land Utilisation Categories in Walled City of Delhi

The figures for the population density of Shahajanabad has shown a decreasing trend right from 1961.The population of the city registered a positive growth rate of 10.25% during the 1961 census. This was solely due to the immigration to the city core and proliferation of refugee colonies which started to sprang up in the area since the partition. However, there has been a clear trend of decreasing population density thereafter for all the successive census years. This is because recently, there has been a clear tendency of outmigration from the city core. The city which once had been primarily devoted for the sheltering of the community is on the verge of being converted to a wholesale market area. The deviating tendency towards a commercial area from being a residential one has led to a tremendous rise in its working population and consequently, put pressure on its infrastructure as well as has been deteriorating the grandeur heritage of the city. This graph further illustrates this fact, that during a span of two decades, the proportion of area devoted to commercial, warehousing and transport utilities have increased significantly.

The results as obtained from the household perception survey also evinces three crucial issues that needs to be addressed i.e. traffic density exacerbated by lack of parking spaces and operation of a variety of modes for passenger and freight movement. The other aspect is water supply where a large number of respondents have reported regarding the poor quality of water supplied. Apart from these, the streets are too narrow, there are open gutters which add to the problem of congestion and associated lack of sanitation and hygiene.

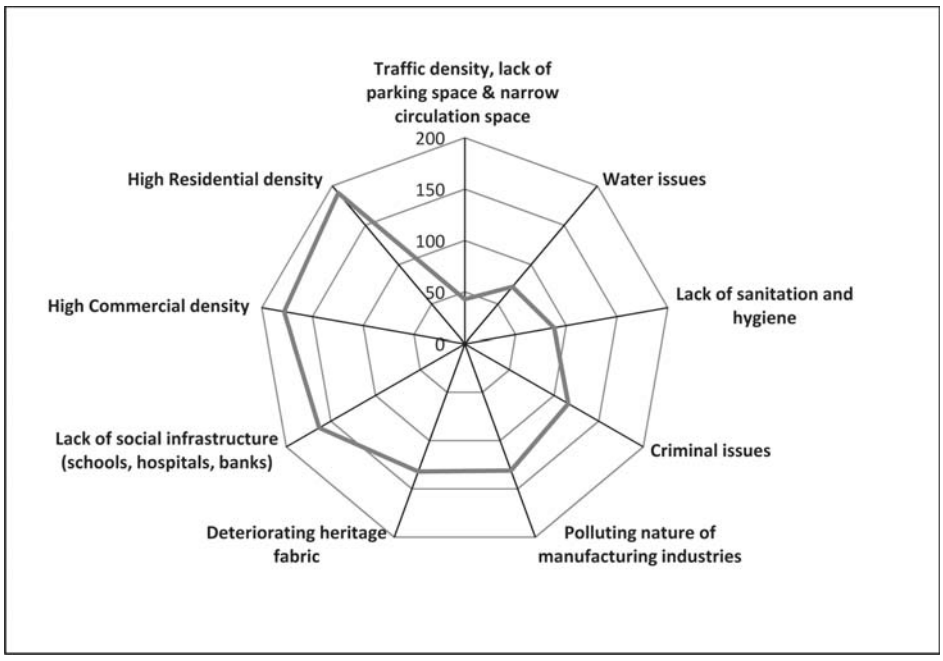

Fig. 5: Composite Score - Household Perception Survey

Planning Framework - A Review of the Master Plans

Given the withering scenario of the once exuberant heritage of the city of old Delhi, the proposals in the Master Plan have also been oriented to boosting up the local economy by growth of traditional crafts bazaar, festivals and heritage walks to attract tourist inflow into the area. However, a chronological review of the master plans has revealed that there are a number of issues that has emerged pertaining to the governance and redevelopment of the walled city. A few of them as perceived by the researcher has been enumerated below:

The matrix below provides a list of the different attributes that have been taken up pertaining to the walled city in the three master plans of Delhi. First of all, a number of aspects that were considered in the previous master plan are missing in the later despite the fact that such targets have not been achieved. For instance, the master plan for 1961 had proposed that there will be no land in the walled city under industrial use. However, the same is lacking in the 2021 master plan despite the fact that a large number of hazardous chemical manufacturing units exist in the katras about which the people have shown concern. Moreover, there has been no mention of upgradation of water supply and sewerage system in the MPD 2021 despite the fact that in accordance to a perception survey 2013 by the Shahajanabad Redevelopment Corporation, it has been observed that the poor and under privileged struggle for access to water during the summer, while the highest proportion of the respondents from Walled City (76%) reported issues with Water Quality. The MPD 2001 proposed for the revitalization of residential areas by maintaining the traditional

Table 1: Attributes undertaken in Master Plans for Redevelopment of Walled City of Delhi

Attributes taken under consideration	MPD 1961	MPD 2001	MPD 2021
Delimitation of non residential activity		√	√
Shifting of Industries and other manufacturing unit	√	√	
Upgradation of Water Supply & Sewerage system		√	
Electrification and Fuel Supply System			√
Upgradation of Physical and Social Infrastructure	√	√	√
Traffic and Transportation restructuring		√	√
Structure and Spacing of buildings	√		
Heritage Conservation		√	√
Green Initiatives			√
Sanitization and environmental hygiene		√	
Revitalization of residential areas		√	

Source: Compiled from Master Plans of Delhi by the Author

character and providing with complete physical and social infrastructure to the households, which is however completely lacking in the MPD 2021 despite the dilapidated fettle of the residential places.

While the 1961 MPD had put focus on the upgradation of trade and commercial activities in the walled city, since it was perceived that if the central business district of the capital continues to grow as a major hub of commercial and distribution activities, it will develop as an important financial centre. However, subsequent master plans have strictly opted for the delimitation of such activities pertaining to trade and commerce for the development of the area as a residential hub rather than a commercial one.

The idea of Collaborative Governance – A critical account of the role of different agencies involved

The concept of Collaborative Governance comes under the umbrella of the different approaches to governance. The neoliberal era with its emphasis on privatization had ushered in a new system of governance that involves the public sector, the private sector as well as the local community. Collaborative Governance refers to a governing arrangement where one or more public agencies directly engage non-state stakeholders in a collective decision-making process that is formal, consensus-oriented, and deliberative and that aims to make or implement public policy or manage public programs or assets (Ansell and Gash 2008).

Now, bringing this into the domain of the present research of the revitalization of Shahajanabad, the major agency involved is the SRDC. However, the Master Plan of 2021 notifies the North Delhi Municipal Corporation (NDMC) to be the nodal agency in the decision making and planning followed by implementation of any redevelopment proposals concerned with Shahajanabad. Apart from this, a number of other government agencies are also involved in restoring the long lost glory of the city like Public Works Department (PWD) and para-state agencies like the Delhi Jal Board (DJB), Delhi Traffic Police (DTP), Delhi Fire Service (DFS), Bombay Suburban Electric Supply (BSES) Yamuna Limited and Indraprastha Gas Limited (IGL). The revival of the heritage value is been carried on by agencies or organizations like the Heritage Conservation Committee (HCC), INTACH and DUAC. Private entrepreneurs have also come up like the OMAXE Private Limited intended with redevelopment of multi level parking facility with commercial complex just a few steps ahead of the Chadni Chowk Metro Station.

Delving into the Redevelopment Projects

So far, the detailed project report has envisaged for the redevelopment of five selected areas in Old Delhi. These include the Jama Masjid Precincts, Chadni Chowk, Esplanade Road, Daryaganj and Lothian Road. However, till date, only the Chadni Chowk Redevelopment Project (CCRP) have come to the ground, apart from the Heritage Corridor of the Delhi Metro Rail Corporation (DMRC) which was also incorporated as part of the revitalization of the deteriorating heritage of the city.

The Heritage Corridor

Since heritage conservation has been considered as one of the major aspects pertaining to the

redevelopment of the old city, a rather ambitious step has been taken with the establishment of the "Heritage Line" by the Delhi Metro Rail Corporation. The name heritage line has been given since it passes through some of the grandeur heritage sites of Old Delhi like Jantar Mantar, Ugrasen ki Baoli, Khooni Darwaza, Delhi Gate and so on. Presently, the line connects Janpath to Kashmere Gate, traversing through five stations in between, namely, Mandi House, ITO, Delhi Gate, Jama Masjid and Lal Quila. Officially inaugurated for the public in May 2017, the corridor has brought about a new exuberance to witness the rich historical background of Delhi dotted with numerous heritage monuments. The metro stations coming under this line has been sculptured with myriad types of art work as a step to revive back the decaying heritage of the city.

Chandni Chowk Redevelopment Plan

As an important stretch of linkage in the old city, Chadni Chowk has been a hub of economic activities, starting from street vendors who sell a wide variety of products like fruits, vegetables, handicraft items and decors to a number of commercial establishments which are popularly known as "katras" selling ethnic dress materials. The area also serves as an important freight distribution centre. However, these mixed land utilization pattern of the area adds not only to the problem of congestion but also certain conflicts in the mobility domain. There are a number of safety issues too in the form of tangles of exposed electrical cables which may trigger fire hazard. In context of these, the CCRP came up in the year 2009 although the actual work started progressing from December 2018 onwards. The plan as implemented by the SRDC has proposed for the redevelopment of the area by transferring all utilities like electric cables, water and gas pipelines underground, followed by widening of the central verge, carriage ways and footpath in tune with its objective of making it a pedestrian friendly zone.

On the impact of Redevelopment of the Walled City

Although the long term effects of the redevelopment of the Chadni Chowk area may brew up positively on the notion of city beautification, however, for the time being, it has been adversely affecting the scale of business of the traders who have been continuing their traditional business in the katras along either sides of the chowk for a long time. A focused group discussion has unmasked multiple problems faced by them.

The redevelopment work has significantly reduced the parking space in the area and cycles and bikes which were previously parked along the road are mostly not allowed. Hence, the traders have to park their vehicles in the multilevel parking complex that was being developed a few metres away from the metro station and walk the entire stretch along with the goods to the shop where they carried on their business. Since rickshaws are allowed to enter into the market, they often load their goods into it, but it has resulted in an increased transportation cost for them. Moreover, since the plan is more oriented to the shifting of utilities on the chowk between Red Fort and the mosque, vehicles like auto, carts and e rickshaws are not allowed to enter between 9 am to 9 pm.

The land price has also been going up. Traders who run rented shops in the katras have reported of their rents being hiked up recently by 18 – 20%. Moreover, with the objective of making

it a pedestrian friendly zone, taxis and cabs are not been allowed to enter into the area. This has led to reduced customer in flow who used to come for shopping using such modes and associated effect on the net sales and income.

Governance Challenges in Redevelopment of the Old City

A. Multiplicity of institutions in the revitalization strategy: Although the MPD 2021 has identified the NDMC to be the main body in the redevelopment of the area, the actual progress is been largely done by the SRDC. Apart from that there are a number of other agencies, whose work domain largely coalesces with one another. Apart from that, there is also lack of information among the agencies regarding each other's sphere of work.

B. Changing governance for the redevelopment plan: The proposal for redevelopment of the walled city was first initiated by the Municipal Corporation of Delhi (MCD) in consultation with an architectural agency which was appointed to draft the plan. After MCD's trifurcation, the project was given to the NDMC, and in 2014 it was handed over to the PWD, and later to the SRDC. This changing governance has led to numerous disagreements over the plan among the agencies coupled with a lot of modifications that has crept in with the handover of the plan to different agencies over time.

C. Conflicting proposals of the agencies: Since a number of agencies are involved in the revitalization process, some of their work domain seems to be coalescing with one another. For instance, while the Zonal Development Plan as well as the DUAC have explored opportunities for the reuse of heritage buildings through private investment for increasing tourist inflow, the proposals of the HCC seems to be in direct conflict with it as it has asserted that no development or redevelopment or any kind of engineering operation inclusive of repairs, renovations shall be allowed in the heritage buildings.

Another example may be cited here where the Archaeological Survey of India (ASI) and DUAC have raised objections against the development of the multi-level car parking facility in Gandhi Maidan on the ground that it will spoil the aesthetics of the area. Even the ASI has objected to the construction of the central verge on the ground that it will diminish the glory of the historic Chandni Chowk.

D. Jurisdiction at different levels: One of the major governance challenges in the revitalization process is itself embedded in the governance structure. This is because as the seat of both the Government of the National Capital Territory of Delhi and the Central Government, the different agencies that are involved in the process get their plans implemented, and finance as well as report to different ministries. While the para state agencies like the DJB, DTC, DFS and DUAC report to the State Government, other agencies like CPWD report to the Union Government.

E. Operation of the work at different scales: The multiple agencies involved in the redevelopment process operate at different spatial and political scales. For instance, while a plan at the upper level has been already framed by the SRDC in collaboration with the

PWD for the installation of sewerage lines, water kiosks and water supply lines, the municipality has however through the ward councilors in some of the wards is on their way in laying down sewerage lines. This reflects not only lack of information among the stakeholders but creates confusion in the way of implementing the broader plan.

F. Problem with different power structures in the community: Firstly, there are objections that are been constantly raised by the different traders' associations in the area because they are of the view that pedestrianisation of the chowk will lead to hampering of their scale of business. Therefore, conflicts in those fronts have led to delay in the progress of the work for months.

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Environmental Problems due to Joka- B.B.D. Bag Metro Railway Project Along Behala -Taratala Route in the City of Kolkata, West Bengal

Alpana Ray[1] and Sudip Roy[2 *]

Abstract : *The construction of new metro railway project or the expansion of the existing metro system invites environmental problems in densely populated areas. The metro system after construction and commissioning will definitely reduce the pollution level and will be highly convenient and Low Carbon mode of Public Transport. But the construction stage aggravates different environmental problems as it passes through densely populated and high vehicular traffic areas. Joka-B.B.Bag Metro Project inaugurated in September 2010 through Behala Taratala areas which are 18.72 k.m. long is creating some problems both to the environment and the people. The delay of constructional activities has led to many environmental problems which led to Diamond Harbour road very narrow, accident-prone and polluted. This paper deals with all the aspects of minimizing the negative environmental effects in planning and implementation of metro projects in highly polluted areas especially when the pollution level of certain elements are above the acceptance level. The paper throws light on the management system which will be helpful for any future project.*

Keywords : *Metro Railway, Behala-Taratala, Kolkata, Environmental Problems*

Introduction

Metro Rails are mass rapid transit system which is totally separated from other modes of the transport system in an urban area. It is characterized by their high capacity to carry passengers i.e. 50,000 to 65,000 per hour on an average at an average speed 20-35 km/hrand very high-frequency operation and also promoting Low Carbon Transport in cities (Teewari, 2014). Though it is 20-30 times costlier than Bus Transit system among the policymakers, there has been a growing interest to build Metro railways to address the expanding population of the cities. In addition to this, it is perceived to have higher comfort levels, speed and efficiency than any other transport (Mohan, 2000) and play an important role in reducing air pollution and road traffic congestion and accidents.

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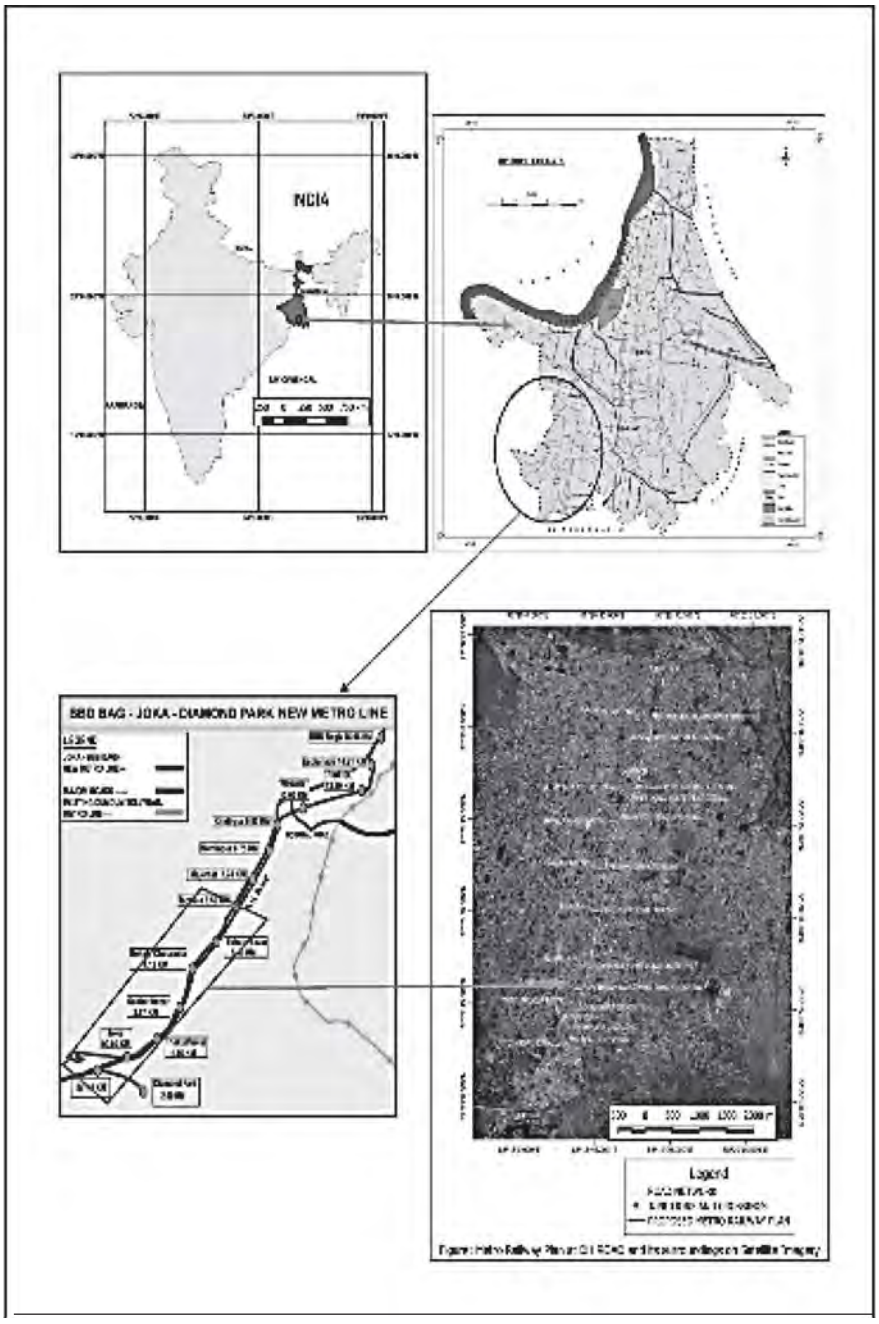

Fig. 1 : Location Map of the Study Area

Thus the Planning Commission has recommended rail transit project under twelfth Five Year Plan for Indian Cities with population exceeds 2 million and cities with a population in excess of 3 million to construct the Metro rails (Planning Commission, 2011). After the completion of the Metro Project, it will certainly reduce the pollution level and convenient mode of public transport but also aggravates different problems mainly waterlogging, pollution, traffic congestion during the construction stage. As metro alignment passes through very densely populated areas so the constructionphases aggravate different problems.

Behala is very densely populated area located in the southwestern flank of Kolkata city (Figure:1) and is very vulnerable interms of different problems like traffic congestion, a waterlogging problem during monsoon months, and high level of air pollution and noise pollution.Behala is one of the best oldest residential areasand also known as an important industrial area of the city with total inhabitants 5,26,460 (Census 2011) in the ward between 115,116, 118….132(Figure:2).

Behala comprises one of the largest suburban agglomerations of the city of Kolkata. It consists of many small localities like Parnasree Pally, Taratola, Sahapur, Behala tram depot, Manton, Chowrasta (Barisha), Shakherbazar,Silpara, Kadamtola, and BehalaThakurpukur. The huge growth of population, especially since the early eighties, resulted in the area being on the radar of the daily wage earners, common populace and educated classes. Due to this enormous an unplanned growth, the traffic is by a large dependent on the arterial Diamond Harbour Road in spite of the availability of the parallel James Long Sarani (commonly known as Bypass or Rail line since the old and now defunct Kalighat-Falta Railway ran here) as an option. But after the construction of the Taratala fly over a large portion of the traffic flows through James long Sarani to avoid traffic congestion causing the development of other areas of Behala.

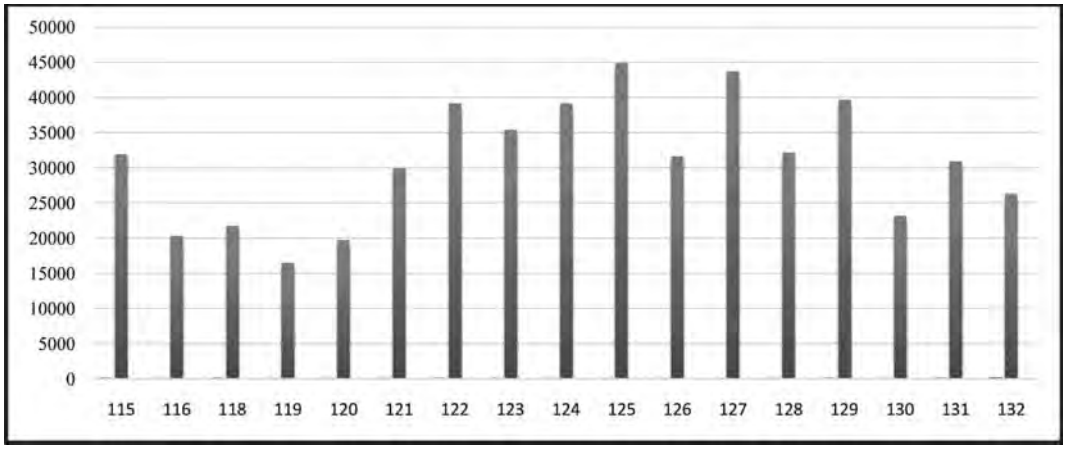

Fig. 2 : Population in Behala (Wards 115- 132), 2011

A tram line used to run through the centre of Diamond Harbour road from Joka to Behala tram depot till around 2005 and the service on this stretch has been withdrawn due to the elevated metro railway construction on the Diamond Harbour Road which will run from Joka to BBD Bag metro rail project in presence of Central Finance Minister and Governor of West Bengal in Sept 2010. The 18.72 km long Joka to BBD Bag metro got stalled because of alan issue leaving Diamond Harbour road narrowaccident-prone an extremely polluted.

The study area i.e from Thakurpukur to Taratola (6.5 km) the progress of the project has been quite steady with Railway Vikash Nigam Limited (RUNl) but the construction of metro rail in the thakurpukur to taratola region is creating some problems both to the environment and to the people. The delay in the construction of the Joka – BBD Bag metro railway on Diamond Harbour road has led to many physical and socio-economic problems to leaving Diamond Harbour road narrow accident prone and polluted. The stations proposed in the section are as follows (Table 1).

Table:1 Proposed Stations from Joka to B.B.D Bag

Name of station	KM (Approx.)	Remarks
Joka	0.000	New Station
Thakurpukur	1.455	New Station
Sakher Bazar	2.670	New Station
BehalaChowrasta	4.130	New Station
Behala Bazar	5.460	New Station
Taratala	6.500	New Station
Majerhat	7.740	New Station
Mominpur	8.755	New Station
Khidirpur	9.870	New Station
Victoria	12.025	New Station
Park Street	13.290	New Station
Esplanade	14.215	New Station
BBD Bag	15.075	New Station

Source: Metro Railway, Kolkata

The study area i.e from thakurpukur to taratola (6.5 km) the progress of the project has Extension project for Rs. 294.49 Cr of BBD Bag – Joka new Metro line to IIM and Diamond Park for 2 km has been sanctioned in the Budget of 2012-13. The work has been given to RVNL. The station's proposed stations are as follows (Table:2)

Table:2 Proposed Extended Stations from Joka to Diamond Park

Name of station	KM (Approx.)	Remarks
Joka	0.00	New Station
IIM	1.00	New Station
Diamond Park	2.00	New Station

Source: Metro Railway, Kolkata

Objective and Methodology

To have a proper idea about the environmental problems due to Metro railway construction in the study area includes the following objectives

- To evaluate the problems of Traffic congestion due to construction activities in the study area.
- To analyse the different issues and concerns which are related to air pollution in the studyarea.
- To identify the problems of water loggingin the study area and to find out the affected areasin and around the proposed metro route.
- To suggest possible solutions to avoid such problems in the study area.

This study is basically descriptive in nature and based on secondary and primary information. Both qualitative and quantitative methods have been applied tothis research.The present research work is based on the application of modern as well as a conventional methodology with intensive fieldwork. The analytical part of the research is based on the compilation of various secondary data and also an analysis of primary data from field visits to fulfil the objective. Secondary data obtained from Metro Railway office, Behala Municipality offices, archival sources, downloaded information through websites, and the suggestions and recommendations made by the interviewing the common people who are sufferer to analysis the research problems. A structured questionnaire based on an interview was conducted to study the research problemsin and around the area. The nature of the present research work is explorative and the whole work has been done by descriptive as well as analytical methods.

Problems Associated with Metro Rail Construction Activities

Traffic Congestion

With increasing traffic demand, coupled with an increasing number of vehicles on road, the problems related to traffic congestion, road accidents, environmental pollution have increased magnificently over in the last few years. One of the most accepted methods of improving traffic congestion in the cities has been to improve efficient Public transport system (Bhutani et al., 2016). So the objective to build the Joka – BBD Bag metro is to reduce the traffic pressure on DH Road,

a national highway NH-117and also on Behala- Thakurpukur area. But the construction of a metro line from Joka to Majherhat is under many disputes from the beginning of the project (July 2011). The deadline is being delayed due to availing permission from the defence authorities an also due to the land issue problem. The completion schedule (Joka–Taratala) was postponed from early 2014 to 2015-16 and now it is postponed to June2018.

A flank of Diamond Harbour Road, the major thoroughfare in Behala has been blocked several places – Pathakpara, Silpara, Behala-Chowrasta and Thakurpukur because of metro construction and work on a waterline. The traffic comprising heavy lorries, buses, autos and cars from both directions move along the single lane. Snarls and chaos are natural outcomes. The cars and bikes and some superfast deluxe buses try to steer clear of these traps by taking James long Sarani turning the road into a second choke pot. The overload triggers massive traffic congestion during peak hours. The loose stone chips mounds of sand and muck from the construction site spill on the road. The stretches near Thakurpukur, Kadamtola and Behala-chowrasta are particularly hazardous.

The overloaded tracks often speed along the road at well over the speed limit of 60km/hr with little regard for traffic rules and fellow motorists. They take sharp turns and switch lanes suddenly. The stretch between Pathakparain front of Orient day school and Behala bus stand number 14, opposite silparabasketball courts are always lined with buses, cars and trucks. This is a no parking zone. The D.H Road is a national highway (N.H 117) and always reveals a good percentage of traffic flowduring peak time. Though it is congested nowadays due to the constructions of Joka-BB Bag metro link.

The primary survey also reveals the fact that autorickshaw, private buses follow the D.H Road most and the bikes, cycles, rickshaws and public buses prefer James Long Sarani.There are some bus stands which are not usable due to the diversions the road space is being reduced. The lack of traffic management near the diversion area is another problem resulting in accidents. The road diversion has increased the flow of vehicles through James Long Sarani leading to traffic congestion in James Long Sarani and lack of traffic police here has increased the speeding of two-wheeler leading to accidents, thus the road diversions and lack of management is the main problem. The bad and deteriorating condition of D.H Road has decreased the accessibility and thus increased the accessibility in James Long Sarani leading to congestion here. The reasons behind James Long Sarani congestion are a bad condition of D.H Road (NH-117) is road diversion road space is narrowed in D.H Road due to the building of metro stations traffic congestion on D.H Road has increased the flow of vehicles through James Long Sarani. The main problem faced by the people living near James Long Sarani is traffic congestion and accident.

Temporal accessibility analyses along DH Road and its adjacent James Long Sarani showing the decreasing level of accessibilities along with most important settlement pockets of South Kolkata. Shimble Index method has been used for this purpose (Figure:3). Shimble Index is the addition of the lowest number of arcs in between a particular station and adjacent stations or nodes in a topological map and the lowest number reflects the highest accessibility condition and the highest number reflects the lowest accessibility condition. The very high accessible areas are from

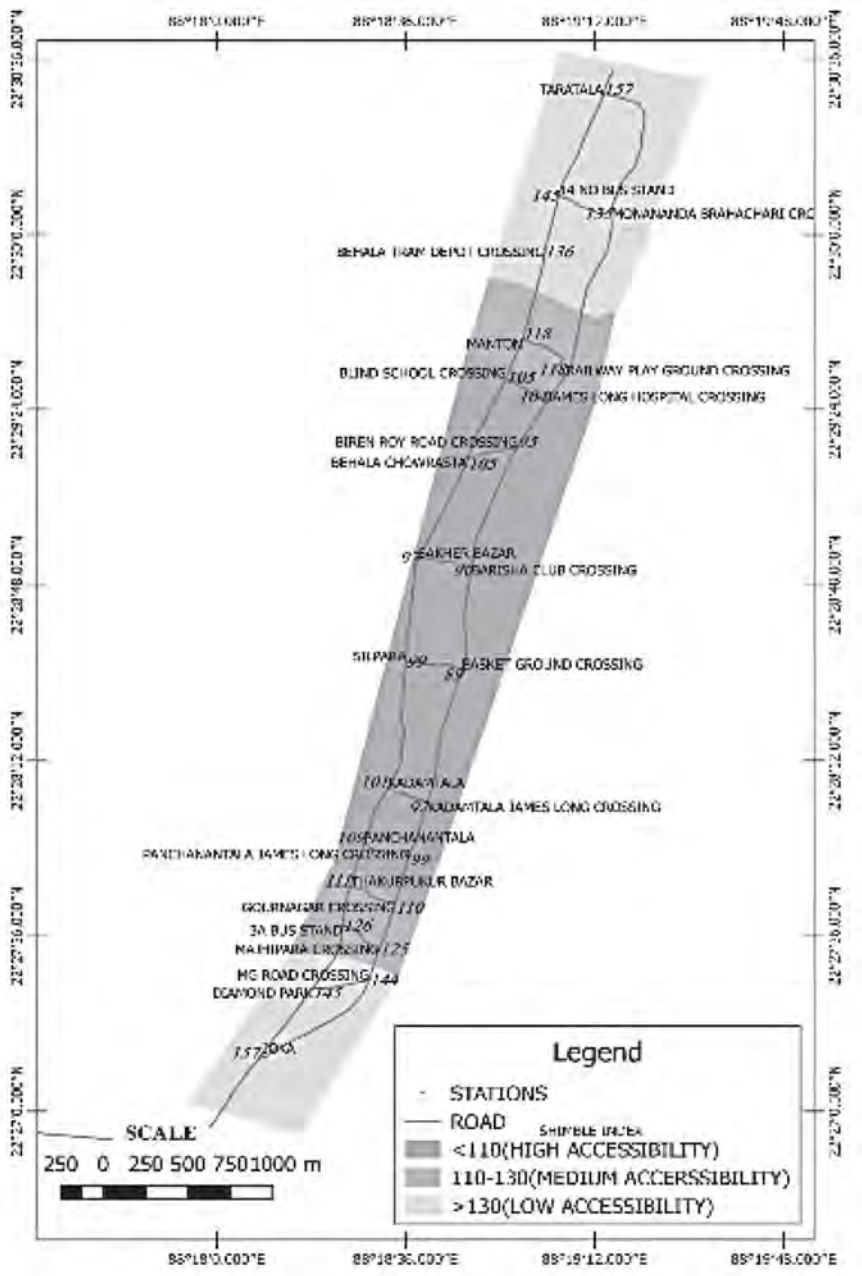

Fig. 3 : Accessibility Map prepared by calculating SHIMBLE INDEX (Shortest Path Matrix) showing level of accessibility along Joka to Taratala (D H Road)

Sakherbazar to Thakurpukur and Behala Chowrasta to Manton is the most accessible area as D.H. Roadis connected by the James Long Sarani by several linking roads.These are totally affected along the route for road diversion during the metro railway construction and the high accessible areas of the map have become moderately and less accessible (Figure:4).The shimble index values are increasing near about 20 which indicates that all thevehicles have to be diverted through James long Sarani by several linking roads.

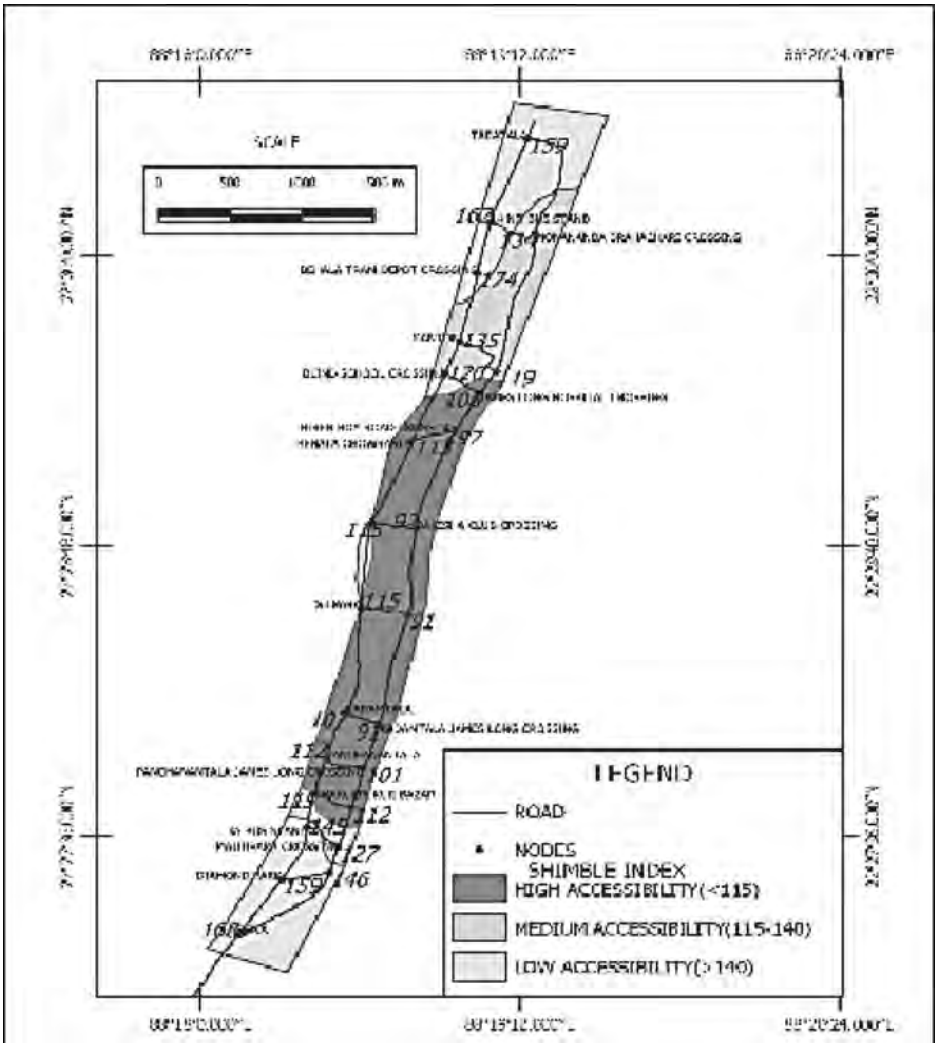

Fig. 4 : Accessibility Map prepared by calculating SHIMBLE INDEX (Shortest Path Matrix) showing the decrease level of accessibility along Joka to Taratala (D H Road) at the time of road diversion at Silpara to Sakher Bazar

Air Pollution

Air pollution has become a very serious issue in the study area in recent times due to metro rail construction activities, and the quality is air turning out to be very poor and causing manyhealth issues among the public.With the increase in thenumber of vehicles on roads, construction activities and industrialisation are some of the reasons that have led to pollution (Verma,2003).To meet up thepopulation pressure more infrastructural facilities are needed and thus increase the pollution level. To solve the problem of inadequate infrastructural facilities city planners plan to construct metro rails to relieve traffic congestion on the road and consequent reduction in pollution level (Kumar,2003). Metro rail construction activities in Behala–Taratala area aggravates the air pollution in the environment.Trash burning is carried on a regular basis. There are huge dump-yards where huge quantities of trash are being burned regularly, causing pollution in the air. Moreover, construction activities also create dust like cement, wood trash etc which also results in air pollution.

The Air Quality Index (AQI), in Kolkata, showed 409 in Nov'2018 and 415 in Dec'2018, which is considered as "Poor". The city residents breathe 5 times of bad air and around 71% of people suffer from respiratory diseases. Pollution levels rise rapidly in winter due to the low speed of wind and damp weather. Kolkata, as usual, has damp weather and the dust particles get trapped easily. PM2.5 is not available during all the seasons but it increases at the start of winter even the Air Quality index rises above 300/400 during the winter season. The pollution and bad air quality is at

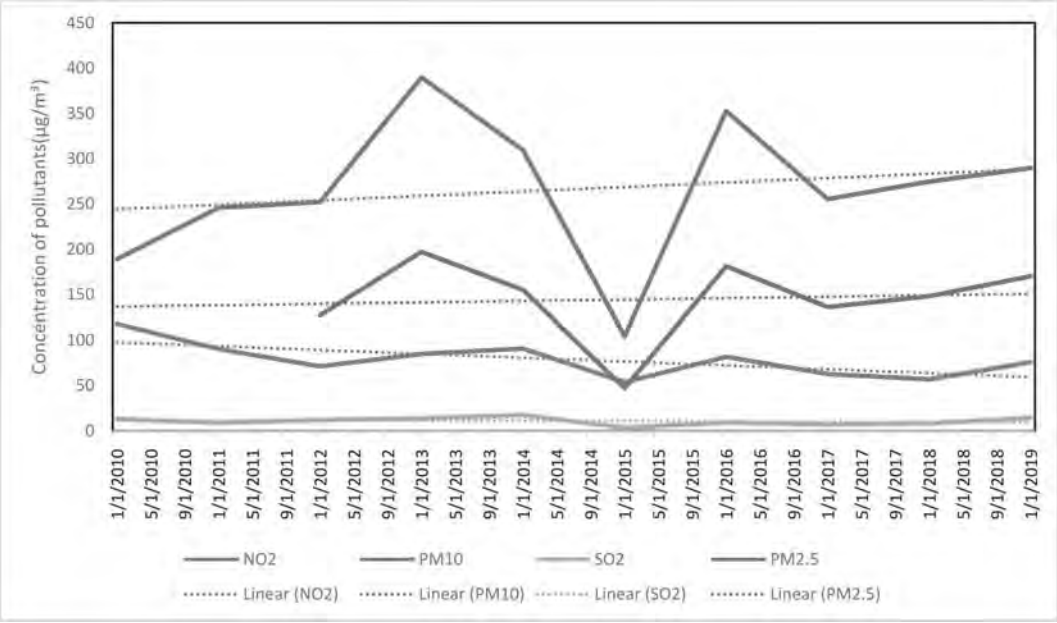

Fig. 5 : Temporal Concentration of pollutants(µg/m³) at Chowrasta

peak during night time and early in the morning.Most of the people suffering from respiratory diseases are non-smoking people. The existing level of pollution like Suspended Particulate Matter (SPM), Co^2, So^2, No^2 are either already on the higher side or above the acceptable level causing serious health problems. The Figure:5 shows that before the construction activities in the year 2010 PM10 was 189 $\mu g/m^3$) which was quite low but 2013-2019 it is increasing at a faster rate and it is also true for PM 2.5. Metro construction activities have aggravated air pollution level in Behala Chowrasta area. Air quality index has also increased from 159 in 2010 to 338 in 2019.

Any rise in pollution level beyond the prescribed limit has a serious impact on the health of people(Goel et al.2014). Air pollution leads to many health hazards making it difficult for people to breathe and survive in a clean environment. According to experts and doctors, Kolkata should also take measures same as in Delhi to deal with air pollution or it will lead to serious health issues among the public. More deaths due to lung cancer and heart attacks are the major concern in the present era. The most affected are the school going and college going students, who fall prey for asthma. People who are on roads for long periods such as dwellers, hawkers, drivers of public transport are at more risk than anyone, as they inhale more of these harmful gasses. People are at high risk of respiratory disorders and other disorders due to rising air pollution. People also suffer from irritation in eyes, sneezing, cough, allergies and body rashes.

Waterlogging

The heavy shower always caused water logging in many pockets of Behala Thakurpukur region. The main reason for waterlogging on D.H Road is improper drainage system, low terrain, increase of built-up areas and lack of management. The construction of the metro link has increased the water logging condition even in the light spell of rain as the construction materials are choking the drainage system. The underlying surface has changed due to the construction of pillars for the metro flyover, water is getting logged on the low areas which are also logging in the potholes created by the lorries (heavy vehicles i.e more than six wheels) carrying construction materials. Thus waterlogging is another problem on D.H Road which has been increased due to the building of metro link. Narrow road space due to encroachment by street hawkers, unauthorized shops under Metro flyover, illegal settlements and choking off the drainage due to the dumping of construction materials are the reasons for waterlogging problem in the study area. The areas like Behala Tram Depot, Behala- Chowrasta,Sakherbazar, Silpara, Thakurpukur are all waterlogging prone areas due to Metro Railway construction (Figure: 6).

Conclusions and Recommendations

The unplanned growth of the Behala area in the absence of a proper master plan is the main problem that isleading to the degradation of this virgin environment from the beginning.

The primary survey in the Behala Thakurpukur area reveals that the problems of waterlogging, road diversions unauthorized shops bad condition of road and traffic footpath problems etc have

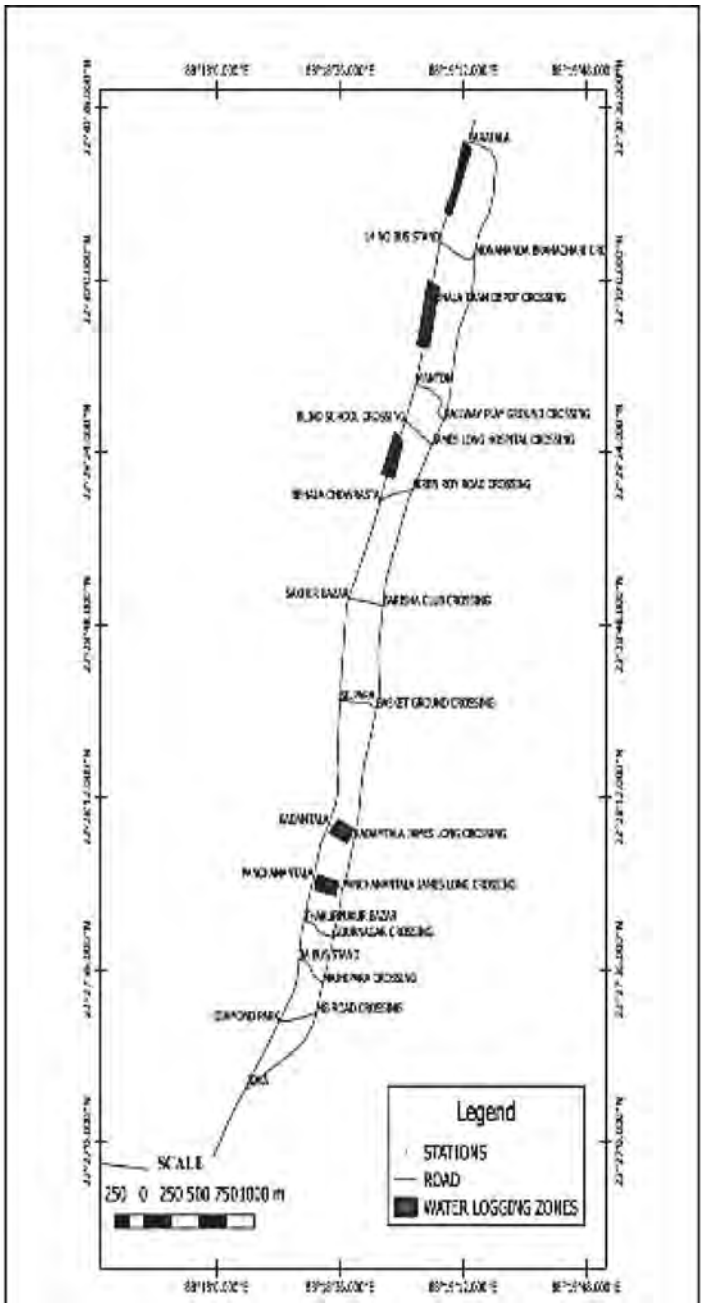

Fig. 6 Map Showing Water Logging Zones with bad road condition (pot holes and shallow dugs)

Plate 1 & 2: Water logging at D H Road in the rainy season.

Plate 3: Road diversion at Silpara

Plate 4: Excavation at DH Road for Metro construction

Plate 5: Dumping of construction material at DH Road.

Plate 6: Dumping of construction material at footpath and blocking of footpath near Thakurpukur

increased due to the constructions of the metro project in this area. The lack of management and unplanned growth and development in this area is the main reason for the above problems.

The infrastructure projects play an important role in the development of a nation and these are also accompanied by significant environmental and social impacts during its construction phase of the project (Kumar, 2003). Metro railways construction activities in densely populated and polluted areas invite different environmental, social and other related critical issues which need to be studied and addressed carefully so that this mega-infrastructure will be socially and environmentally acceptable. Metro rail projects take many years to get operational so that environmental management can be suitably used to ensure that they are environmentallysustainable and socially acceptable (Karthik, 2018).

Though the environmental impact of the metro projects is assessed and necessary mitigation is already planned but overall comprehensive planning is usually lacking which results in an increase in pollution level and other environmental problems.So it is necessary for the metro planners to take into account all the possible environmental problems and plan remedial measures accordingly.

At different locations of Metro rail construction where the pollution level has exceeded the permitted level or is on the higher side in the study area, construction activity needs to scrutinized to protect the environment. The type of material used plays an important role in deteriorating the environment.The use of ‘precast’ concrete structural members, high capacity cranes, battery operated trucks will provide a big relief from adverse environmental impact (Kumar, 2003).

A proper master plan is to be chalked out to get rid of these problems. The drainage outlet should be cleaned to check pollution and spread of diseases and reduction in waterlogging. The hawkers should be removed to some place through management so that they can earn their livelihood & also the problems caused by their presence on D.H Road can be reduced. The temporary settlements should be checked by the contracted company related to the project. The condition of D.H Road should be improved as it is a national highway, proper traffic management is required and more traffic police are needed there.

The road diversions should be properly done and the increase of traffic police in the diversion area also in James Long Sarani is needed. The proper disposal of solid waste should be done by the metro railway authority. The checking of the pollution level should be done especially near the hospital area and near the educational institutions. To materialize all the suggestive measures to upgrade environmental and socio-economic conditions of the area. A strict and regular administrative vigilance is the need of the hour. Development is good but the development should be environment-friendly i.e not harming the environment and for this proper plan must be chalked out by the developmental committees. A proper master plan should be taken as that the environment and the common people affected by the construction of the metro link.

Recent studiesshow that an increase in pollution level due to the metro railway for short duration in polluted areas of the study area has an extremely adverse effect on the health of the people. Adequate consideration of environmental aspects is to be given in all aspects of planning and construction of the metro project to match with the special circumstances that prevail in highly polluted and populated cities. By proper planning and execution, the adverse effect on highly polluted and populated zones of the city can be minimised so that health hazards are minimised. Such planning acted upon effectively will also should the public opinion in favour of increased public cooperation and goodwill.

A more personal approach is required for people whose living conditions are getting directly affected due to the metro construction mainly vibration in their building, movement of a large number of trucks, temporary blocking off their pathway, etc. Engineers and their representative along with Public Relation Personnel should take responsibilityto meet directly with such persons and keep them informed about the steps being taken to ensure safety and environment.

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Identifying Destination of Rural Out-Migrants in West Bengal: Correlating Rate of Out Migration With Distance

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Abstract : *Obstructive regional imbalance and disparate development in India, as well as West Bengal, has motivated outmigration from agriculturally and economically depressed rural areas. The rural out-migration choices take place in the economic and social contexts of rural communities throughout India. The paper, using data available in successive census counts unravels the patterns of outmigration across regions in West Bengal.Rural areas have a larger proportion of marginal jobs which results in higher underemployment and also a larger proportion of rural workers are employed in low-skilled jobs relative to urban areas. Among the total migrants at the inter-state and inter-district level, females are more dominant compared to the males in West Bengal. But a greater proportion of males migrate for work and females for marriage. In West Bengal, for male outmigration and rural to urban out-migration flow clearly proves that distance creates a little hurdle to migration if the destination places are economically and industrially developed than distance does not matter. From this point of view, the study of male migration from rural areas of West Bengal is more important compared to females.*

Keywords : *Male out-migration, West Bengal, Regional pattern, Flow of Migration, Distance*

Introduction

Out-migration from West Bengal to different parts of India has a long history. People from different places in West Bengal have not only crossed district boundaries, but they have also gone much beyond crossing the state and international boundary too. Beginning from the 19th century to the post-independence period, in eastern India- especially West Bengal had attracted huge in-migration from other states of India. In the recent past, however, the pattern of migration has changed a lot over different periods. Outmigration has countless impact on the all regions of our planets (Clark, 1986).Poor and rich households dominated streams in rural outmigration (Kundu and Sarangi, 2007). Parganiha et al. (2009) pointed out that most of the rural male persons are migrating far from their village and most of the female out migrants moved to other areas within the same district. Premi (1980) argued that in medium and long-distance males are more migrated to urban areas. After improvement in local transportation facilities, a larger number of workers are living

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outside the city and they work on a regular basis (Zachariah, 1966). The informal sector in urban areas attracts more poor people from rural areas mainly for work (Keshri and Bhagat 2012). Piotrowski, et al. (2013) found that long-distance movement is probably work-related. From the analysis of Jones (1965), rural migration of Central Walse, he concluded that the great bulk of migrants proceed only a short distance and that those migrants proceeding long distances generally go to the large conurbations. Migration from the rural areas to the cities in West Bengal is highly selective for males than the other states (Singh, 1984). On the other hand, landless and marginal households are more likely to migrate compared to large households (Deshingkar et al., 2006; Dodda et al., 2016; Panda, 2016). In West Bengal, especially western *Rarh* region has long record of temporary and seasonal outmigration. Barddhaman district and its surrounding areas were the favourable destination of seasonal migrants (Rogaly, 1998; Rogaly et al., 2001, 2002; Rogaly and Coppard, 2003; Rogaly and Rfique, 2003; Sengupta and Ghosal, 2011). On the contrary, inter-state outmigration of West Bengal elicited that propensity of outmigration increased in recent decades (Debnath, 2019; Debnath et al., 2019).In terms of the male-female composition of such outmigration, females dominated in short distance and males controlledover long-distance migration streams (Debnath et al., 2016).

The rural migration choices take place in the economic and social contexts of rural communities throughout India. Rural areas have a larger proportion of marginal jobs which results in higher underemployment and also a larger proportion of rural workers are employed in low-skilled jobs relative to urban areas. Among the total migrants at the inter-state and inter-district level, females are more dominant compared to the males. But a greater proportion of males migrate for work and females for marriage. Inter-district and Inter-state rural outmigration from this state also depicts that males are more migrated for work and employment purpose and for female marriage is the main cause. From this point of view, the study of male migration from rural areas of West Bengal is more important compared to females. Following specific objectives placed before the study are to identify regional patterns and flow of rural male migration from West Bengal and to find out the correlate the rate of outmigration and distance of destination places.

Database and Methodology

The study is based almost exclusively on secondary sources and data have been collected from different sources like Census of India, Migration Table-D (Place of last residence and place of birth), District Census Handbook, Statistical abstracts of Government of West Bengal.Out-migration from West Bengal has componentsby using migrants by place of last residence, duration of residence and reason for migration (2011).

Rate of out-migration, in-migration and net migration are calculated by using the following formulas (Clark, 1986) -

$$\textit{Out-Migration Rate, OMR} = (O/P).K$$

Where, O = No. of Out-migrants and P = Total Population, and K = 100 or 1000 (a constant).

Census of India provide migration data on the basis of place of birth and place of the last residence. All the data has been calculated by place of last residence. Percentage of male out-migration from West Bengal to others state has been calculated as the percentage of male out-migration to the total male population of the state.The geographical analysis of male out-migration from West Bengal has done at the country level into six arbitrary regions.

Census of India, Migration Table D-3 (Migrants by place of last residence, duration of residence and reason for migration, 2011) used to analysis of inter-state outmigration pattern of West Bengal. The range of outmigration has been classified by using the mean and standard deviation method. The rate of total outmigration varies significantly across the state within and across physiographic regions. Here, ArcMap 10.3.1 software used to prepare the thematic map of inter-state outmigration pattern.

Correlating rate of outmigration with distance calculated by the SPSS (Statistical Package for the Social Sciences). Here, distance is calculated by the Google earth image. Road distance has taken into consideration for the measurement of the distance of destination places of out-migrant. In this case, road distance considered as the distance of each capital of eachstate with the capital of West Bengal. Correlation matrix has been used to correlate the rate of outmigration and distance of destination places. Here, road distance considered as independent variable while different streams of migration envisaged as dependent variables.

Results and Discussion

Males generally migrate for the work and employment purposes and they move to those destinations economically and industrially developed offering greater employment opportunities (Sengupta and Ghosal, 2011; Rogaly, 1998; Oberai and Singh, 1980). This chapter focuses on the inter-state, inter-district and inter-regional flow of out-migrants and different streams of rural to urban and rural to rural outmigration. Briefly, the study is an attempt at identifying regional patterns, flows, source regions, destination, determinants and factors affecting outmigration from the rural areas of the state depending upon the geographical contexts as outlined above.

The volume of different flow of out-migrants is shared by different states and union territories which are shown in table 1. Only a few states, namely the neighbouring state of Jharkhand, Odisha and Bihar, and far off states like Maharashtra, Delhi and Uttar Pradesh received around 67.07 per cent of all out-migrants from West Bengal. In terms of the male-female composition of such outmigration, females dominated in short distance and males dominated long-distance migration streams (Debnath et al., 2016).

Figure 1, 2 and 3 show the nature of the distribution of out-migrants from West Bengal. It is clear from the figure that the intensity and consistency of out-migrants are higher in the neighbouring states of West Bengal compared to those states which are located far away. Bihar, Jharkhand, Orissa, Sikkim and Assam are the neighbouring states of West Bengal and these states have

Table 1: Total Outmigration as per cent to Total Population, 2011

Name of The States	Total out-migrants (per cent)	Total Male out-migrants (per cent)	Total Female out-migrants (per cent)
Jammu & Kashmir	0.42	0.31	0.50
Himachal Pradesh	0.25	0.37	0.16
Punjab	1.95	2.26	1.75
Chandigarh	0.29	0.39	0.22
Uttarakhand	1.09	1.29	0.96
Haryana	3.15	3.81	2.72
NCT of Delhi	7.58	9.81	6.12
Rajasthan	2.81	3.48	2.37
Uttar Pradesh	9.73	5.85	12.28
Bihar	9.47	3.31	13.52
Sikkim	1.38	1.52	1.29
Arunachal Pradesh	0.29	0.44	0.19
Nagaland	0.16	0.22	0.11
Manipur	0.03	0.04	0.02
Mizoram	0.03	0.04	0.02
Tripura	0.22	0.26	0.19
Meghalaya	0.23	0.27	0.20
Assam	3.94	3.53	4.21
Jharkhand	20.56	11.12	26.77
Odisha	6.85	6.20	7.27
Chhattisgarh	2.24	2.85	1.83
Madhya Pradesh	1.92	2.51	1.53
Gujarat	3.70	5.70	2.39
Daman & Diu	0.20	0.40	0.07
Dadra & Nagar Haveli	0.12	0.23	0.05
Maharashtra	12.88	20.22	8.06
Andhra Pradesh	2.09	2.75	1.65
Karnataka	2.81	4.40	1.77
Goa	0.22	0.38	0.12
Lakshadweep	0.01	0.01	0.00
Kerala	1.27	2.74	0.30
Tamil Nadu	1.20	1.79	0.81
Puducherry	0.05	0.06	0.04
Andaman & Nicobar Islands	0.87	1.40	0.52
India	**100**	**100**	**100**

Source: Census of India, Migration Table D-3: Migrants by place of last residence, duration of residence and reason for migration - 2011

received 42.20 per cent of the out-migrants who crossed the state boundary. Out of the total female out migrants, over half (53.06per cent) of them migrate to these states while a small proportion (25.68per cent) of the total male out-migrants prefer these states as their destination. This clearly reveals the fact that female outmigration has a preference for much shorter distance unlike that of the males.

Fig. 1: Distribution of Inter-State Outmigration from West Bengal, 2011

West Bengal is situated in the central part of eastern India. Due to the locational factor, people of this state migrate in different directions and to different destinations. Figure 2 shows that out of the total male outmigration from West Bengal to the other states of India, more than 10 per cent of male outmigration is to Maharashtra and Jharkhand only. Uttar Pradesh, NCT of Delhi, Gujarat and Orissa received 5-10 per cent of the out-migrants whereas rest of the states and UTs received below

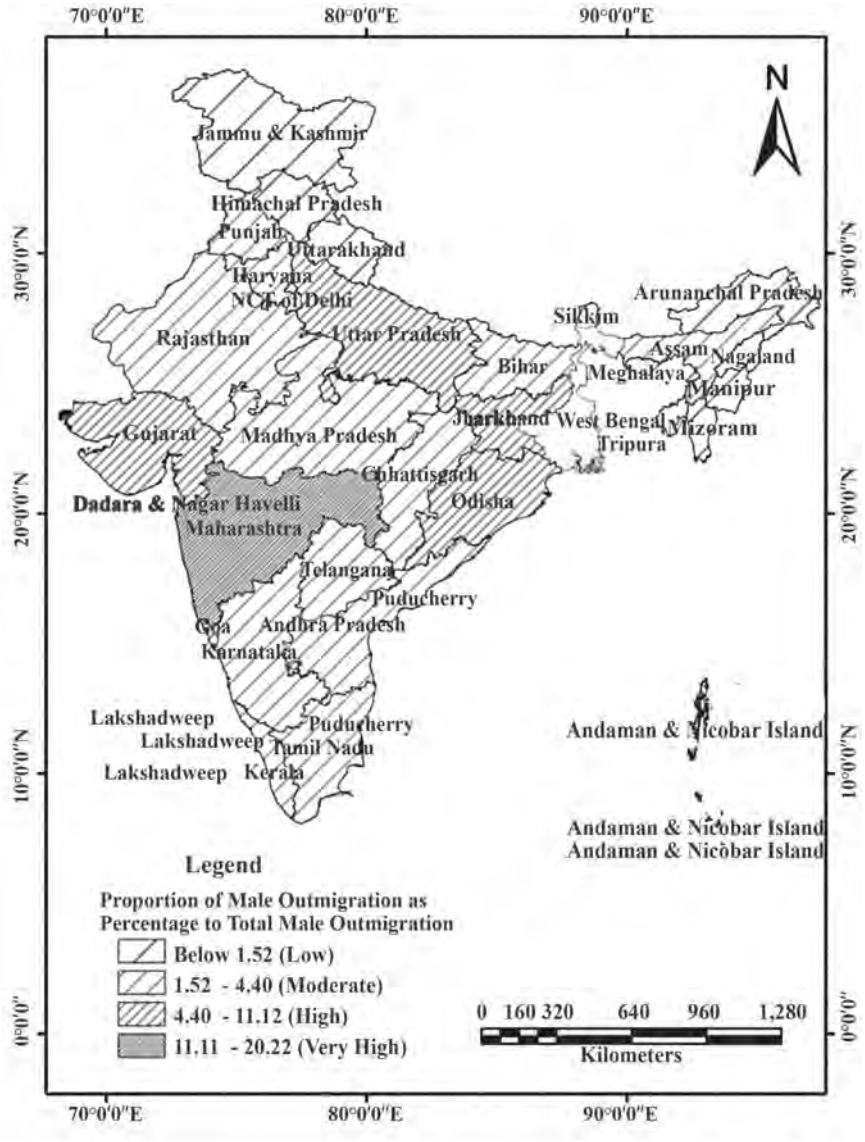

Fig. 2: Distribution of Inter-State Male Outmigration from West Bengal, 2011

5 per cent of all the out-migrants. This migration flow in figure 4 clearly proves that distance creates a little hurdle to migration if the destination places are economically and industrially developed. Though Maharashtra (20.22per cent), NCT of Delhi (9.81), Gujarat (5.70), Uttar Pradesh (5.85per cent), Punjab (2.26per cent), Haryana (3.81) and Karnataka (4.40per cent) are situated far away from West Bengal, these states did attract a large share of the migrants from West Bengal.

Fig. 3: Distribution of Inter-State Female Outmigration from West Bengal, 2011

Inter-state destinations

In terms of inter-state outmigration, females dominate in short distance migration whereas males dominated in the long distance. States closer to West Bengal received more female migrants compared to their male counterparts. Table 1 show that Jharkhand, UP, Bihar, Assam, Orissa, Uttaranchal and Tripura received a greater volume of female migration. Rest of the states and union territories have received a large proportion of male migration from West Bengal. Males generally migrate for work and employment purposes and they moved to destinations economically and industrially developed offering greater employment opportunities.

Table 2: Types of Migration flow from West Bengal to Other States of India, 2011

Types of Migration	Total		Male		Female	
	Volume	per cent	Volume	per cent	Volume	per cent
Total Migrants	2405522	100	953641	39.64	1451881	60.36
Rural Total	1150624	100	415794	36.14	734830	63.86
Urban Total	1149286	100	491552	42.77	657734	57.23
Rural to Rural	621128	100	125985	20.28	495143	79.72
Rural to Urban	529496	100	289809	54.73	239687	45.27

Source: Census of India, Migration Table D-3: Migrants by place of last residence, duration of residence and reason for migration - 2011

Table 3: Male-Female Destination flow of Migration from West Bengal, 2011

Direction	Origin	State and Union Territory (Place of enumeration)
Male Destination	Rural areas of West Bengal	Maharashtra (19.00per cent), Jharkhand (14.09per cent), NCT of Delhi (10.06per cent), Orissa (7.20per cent), Gujarat (5.36per cent), Haryana (5.26per cent), Uttar Pradesh (4.91per cent), Assam (3.94per cent), Kerala (3.45per cent), Rajasthan (3.30per cent), Karnataka, Punjab, Madhya Pradesh, Andhra Pradesh, Kerala, Tamil Nadu, Himachal Pradesh, Chandigarh, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Meghalaya, Chhattisgarh, Daman Diu, Dadra and Nagar Haveli, Goa, Lakshadweep, Sikkim, Pondicherry, Andaman and Nicobar Island ,Uttaranchal and Tripura.
Female Destination		Jharkhand (38.23per cent), Bihar (15.64per cent), Uttar Pradesh (9.49per cent), Orissa (9.47per cent), Assam (4.50per cent) and Maharashtra (3.95per cent).

Source: Census of India, Migration Table D-3: Migrants by place of last residence, duration of residence and reason for migration - 2011

Table 4: Rural-Urban Destination flow of Migration from West Bengal, 2011

Direction	Origin	State and Union Territory (Place of Destination)
Rural Destination	Rural areas of West Bengal	Jharkhand, Haryana, Bihar, Assam, Orissa, Himachal Pradesh, Sikkim, Arunachal Pradesh, Daman dui, Dadra & Nagar Haveli, Andaman and Nicobar Island, Kerala, Nagaland and Lakshadweep
Urban Destination		Delhi, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Tamil Nadu, Punjab, Jammu & Kashmir, Chandigarh, Uttarakhand, Manipur, Tripura, Mizoram, Meghalaya, Chhattisgarh, Madhya Pradesh, Karnataka Uttar Pradesh., Goa and Pondicherry.

Source: Census of India, Migration Table D-3: Migrants by place of last residence, duration of residence and reason for migration - 2011

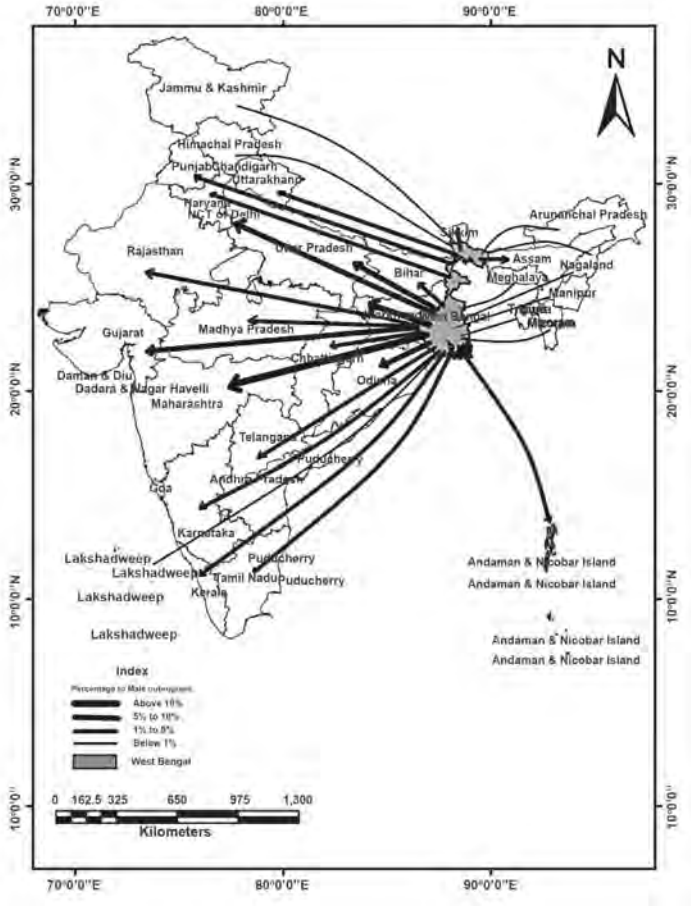

Fig. 4: Inter-State Outmigration Flow from West Bengal, 2011

Figure 4 reveals that the entire Indo-Gangetic plain received a moderate proportion of rural migrants from West Bengal. On the other hand Jharkhand, Orissa and Maharashtra received the highest proportion of rural migrants from the state. Rest of the states and UTs received a negligible proportion of migrants which are far from the state. According to Census, West Bengal as a whole is a net in-migrant state. However, out-migration; especially male outmigration rate has increased over the years. Table 4 shows that most of the states and UTs received rural to rural out-migration from West Bengal. Table 1 shows that among the total out-migrants, 39.64 per cent are males and

Fig. 5: Inter-State Rural to Rural Outmigration from West Bengal, 2011

60.36 per cent in females. However, the percentage of male and female rural and urban migrants is different compared to total migrants. Inter-state rural migration stream consists of 36.14 per cent males and 63.86 per cent females (Fig 2.7). However, inter-state urban migration consists of 42.77 per cent male and 57.23 per cent female migrants (Fig 2.8). Rural males move in two streams i.e. rural to rural and rural to urban. Inter-state rural to rural migration stream consists of 20.28 per cent males and 79.72 per cent females (Fig 2.9). However, inter-state rural to urban migration consists of 54.73 per cent male and 45.27 per cent female migrants from West Bengal (Fig 2.10).

Fig. 6: Inter-State Rural to Urban Outmigration from West Bengal, 2011

The proportion of rural to rural male out-migration is less but this stream of migration is distributed in a large number of states and union territories in India (fig 2.9). Jharkhand (16.53per cent), Orissa (11.77per cent), Bihar (7.92per cent), Assam (6.73per cent), Utter Pradesh (5.98per cent) together have received about 48.93 per cent rural to rural male out-migrants from out of the total rural to rural male out-migrants (figure 5). On the other hand, rural to urban male outmigration has taken place to far fewer states but in large proportion. Figure 6 shows that, only the three states namely Maharashtra (24.70per cent), Delhi (14.07per cent) and Jharkhand (13.04per cent) have received 51.81 per cent of the total male rural to urban migrants from West Bengal (Table 2).

Regional distribution of rural outmigrants

For the purpose of the present study, the entire country is divided into five arbitrary regions i.e. Central high land states, Indo-Gangetic plain states, states of south India, north-eastern states and north Indian mountain states. Table 5 shows that Central high land states like MP, Maharashtra, Chhattisgarh, Orissa, Jharkhand, Daman and Dui, Dadra and Nagar Haveli received the highest percentage of the migrants (i.e. 44.76 per cent) from West Bengal. Not only this region but the states in Indo-Gangetic plain too received around 38.68 per cent migrants from West Bengal. Maharashtra, Madhya Pradesh, Jharkhand, Orissa, Haryana, Punjab, Delhi, Gujarat etc. States are rich in minerals, agriculture, economy, industry and high rate of urbanization which create great pull factors for male migration from West Bengal.

Table 5: West Bengal: Major Migration Destination Regions, 2011

Regions	States	Total out-migrants (per cent)
Central High land	MP, Maharashtra, Chhattisgarh, Orissa, Jharkhand, Daman dui, Dadra Nagar Haveli	44.76
Indo-Gangetic plain	Bihar, UP,Punjab, Haryana, Delhi, Rajasthan, Gujarat, Chandigarh	38.68
Deccan Plateau	Karnataka, Kerala, Tamil Nadu, Goa, Pondicherry, Andhra Pradesh	7.64
North-Eastern Hill States	Assam, Sikkim Tripura, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Meghalaya,	6.28
Northern Mountain States	Jammu & Kashmir, Himachal Pradesh, Uttaranchal	1.76
Islands	Andaman and Nicobar Island, Lakshadweep	0.88
	Total	**100**

Source: Census of India, Migration Table D-3: Migrants by place of last residence, duration of residence and reason for migration - 2011

States in South India, North-Eastern States and North Indian Mountain states received a small proportion of migrants from West Bengal because some states are far from West Bengal; some are economically and agriculturally developed; some are industrially less developed which do not create pull factors for male migrants from West Bengal. Parganiha et al. (2009) pointed out that outmigration is greater in the poorly developed agricultural areas and particularly high among the landless farmers. Most of the rural male persons migrate to far off places from their village and most of the female out-migrants moved to the other areas within the same district.

Table 6 shows the most preferred destinations as far as male and female migrants are concerned. Maharashtra (20.22per cent), Jharkhand (11.12per cent) Delhi (9.81per cent), are the three destinations most favoured by male out-migrants from rural West Bengal whereas Jharkhand (26.77per cent), Bihar (13.52per cent) and Uttar Pradesh (12.28per cent) are the three preferred destinations for female migrants from West Bengal. Among the 35 states and union territories, only ten states have accounted for 74.12 per cent of the total rural male migrants and 85.71 per cent female migrants from West Bengal.

Table 6: Male-Female Variation in Destinations for Migrants from West Bengal, 2011

Place of Origin	Place of Destination		Place of Origin	Place of Destination	
	States	**Per Cent**		**States**	**Per Cent**
West Bengal	Maharashtra	20.22	West Bengal	Jharkhand	26.77
(Male Migrants)	Jharkhand	11.12	(Female	Bihar	13.52
	NCT of Delhi	9.81	Migrants)	Uttar Pradesh	12.28
	Orissa	6.20		Maharashtra	8.06
	Uttar Pradesh	5.85		Orissa	7.27
	Gujarat	5.70		NCT of Delhi	6.12
	Karnataka	4.40		Assam	4.21
	Haryana	3.81		Haryana	2.72
	Assam	3.53		Gujarat	2.39
	Rajasthan	3.48		Rajasthan	2.37
	Top ten total	**74.12**		**Top ten total**	**85.71**

Source: Census of India, Migration Table D-3: Migrants by place of last residence, duration of residence and reason for migration - 2011

Relation of outmigration and distance of destination place

Distance is one of the important factors for selecting a destination place of migrants who are migrated from their native place and this distance also controlled by different other social and

economic factors. Different societal systems like caste, taboos, religious belief are acted together as a social barrier in different society for both the sexes. Stouffer (1940) suggested that the number of persons who want to go a given distance is directly proportional to the number of opportunities at that distance and inversely proportional to the number of intervening opportunities. In West Bengal, these types of social problems are deeply rooted in rural counterparts. In West Bengal, for male outmigration and rural to urban out-migration flow clearly proves that distance creates a little hurdle to migration if the destination places are economically and industrially developed. Though Maharashtra, Delhi, Gujarat, Punjab, Haryana are situated far away from West Bengal, these states did attract a large share of the migrants from West Bengal.

The correlation has been done between the distance of the destination and different streams of outmigration as presented in table 7. All the variables are negatively correlated with the distance of the destination and different streams of outmigration from West Bengal in 2011. Total rural outmigration is negatively correlated with the distance of the destination and the value of the correlation coefficient is negative at -0.543 in 2011 which is statistically significant at 0.01 level of significance. It's mean that if the distance of the destination increases than the rate of rural out-migration decreases (Kundu and Sarangi, 2007; Premi (1980). The relation with total urban out-migration and the distance of the destination is negative (r=-0.321) but poor significant. It's mean that the distance of the destination place is not any direct effect on urban out-migration in West Bengal. High negative correlation (r= -0.627 at 0.01 significance level) between the percentage of rural to rural outmigration and distance of destination suggested that if the distance of destination increases than the rate of rural out-migration decreases. Census of India 2011 shows that about 77.06 per cent among the total rural to rural are migrated in neighbouring states of West Bengal. The relation between the percentage of rural to urban outmigration and distance of destination is not significant and it's associated with poor negative relation (r=-0.262). Its mean that distance of destination place is not any direct effect on rural to urban out-migration in West Bengal. There is a poor negative correlation with total male outmigration and distance. The value of the correlation coefficient is negative (r=-0.158). It's mean that for male out-migration, distance does not matter if the destination place is developed (Premi, 1980; Debnath and Ray, 2017). Inter-state total female outmigration is negatively associated with the distance of destination with the value of the correlation coefficient is negative (r=-0.576 at 0.01 significance level). It's mean that if distance increases than the rate of female out-migration decrease. In general, female are migrated for marriage and migrated in short distance (Zachariah, 1966; Bose, 1965; Piotrowski, at el., 2013). The relation between the percentage of inter-state rural to rural male outmigration and distance of destination is significant and it's associated with strong negative relation (r=-0.595 at 0.01 significance level). It's mean that if distance increases than the rate of rural to rural male out-migration decreases. The great bulk of migrants proceed only a short distance and that those migrants proceeding long distances generally go to the large conurbations (Jones, 1965). Total rural to rural female outmigration is negatively correlated with the distance of the destination and the value of correlation coefficient is negative at -0.619 in 2011 which is statistically significant at 0.01 level of significance. It's mean that if distance increases than the rate of female out-migration decrease. In general, female are migrated for marriage

Table 7: West Bengal: Correlation Between Distance and Different Streams of Outmigration, 2011

Variables	Distance	Rural Total	Urban Total	Rural to Rural	Rural to Urban	Total Male	Total Female	R to R Male	R to R Female	R to U Male	R to U Female
Distance	1										
Rural total	-.543**	1									
Urban total	-0.321	.763**	1								
Rural to Rural	-.627**	.946**	.578**	1							
Rural to Urban	-0.262	.834**	.881**	.610**	1						
Total Male	-0.158	.669**	.931**	.417*	.926**	1					
Total Female	-.576**	.980**	.797**	.947**	.781**	.639**	1				
R to R Male	-.595**	.871**	.645**	.864**	.659**	.587**	.843**	1			
R to R Female	-.619**	.938**	.560**	.998**	.594**	.390*	.943**	.833**	1		
R to U Male	-0.075	.627**	.868**	.347*	.941**	.977**	.574**	.494**	0.325	1	
R to U Female	-.431*	.947**	.774**	.814**	.928**	.743**	.902**	.750**	.807**	.747**	1

*** Correlation is significant at the 0.01 level (2-tailed).*

** Correlation is significant at the 0.05 level (2-tailed).*

Source: Census of India, Migration Table D-3: Migrants by place of last residence, duration of residence and reason for migration - 2011

and migrated more in rural areas (Bose, 1965; Zachariah, 1966; Premi, 1980; Keshri and Bhagat 2012; Piotrowski, at el., 2013). The relation between the percentage of inter-state rural to urban male outmigration and distance is not significant and it's associated with poor negative relation (r=-0.075). It's mean that distance of destination place has not any direct effect on rural to urban male out-migration in West Bengal. Inter-state migration flows indicate that if destination places are developed economically and industrially then distance does not create any problem in migrating. Maharashtra, Delhi, Gujarat, Punjab, Haryana are situated far from this state but they have received a large proportion of rural to urban male migrants from West Bengal. Those who are migrated in long-distance are generally migrated in the developed region or urban areas for the searching job opportunity (Rele, 1969; Oberai, 1984; Keshri and Bhagat 2012; Piotrowski, at el., 2013; Debnath, 2017). The relation between the percentage of inter-state rural to urban female outmigration and distance is significant and it's associated with strong negative relation (r=-0431 at 0.05 significance level). It's mean that if distance increases than the rate of female out-migration decrease. Premi (1980) argued that in the case of short distance, females migrate more in rural areas but medium and long-distance more of them migrate to urban areas. In general, female are migrated for marriage and migrated more in rural areas (Zachariah, 1966; Bose, 1965; Piotrowski, at el., 2013).

Conclusion

On the basis of the analysis of spatial variation in inter-state rural outmigration, it can be stated that people of West Bengal not only migrated in short distance but also in long distance. Females largely migrated in short distance and only one-third male migrated in short distance or to adjacent states. More females migrated to districts in adjacent states of West Bengal whereas more males are migrated long distance to states located far away. Inter-state migration flows indicate that if destination places are developed economically and industrially then distance does not create any problem in migrating. Maharashtra, Delhi, Gujarat, Punjab, Haryana are situated far from this state but they have received a large proportion of male migrants from West Bengal.In a regional context, Central high land and Indo-Gangetic plain region have received the highest percentage of migrants from West Bengal. Maharashtra, Madhya Pradesh, Jharkhand, Orissa, Haryana, Punjab, Delhi, Gujarat etc. are states rich in minerals, agriculture, economy, industry and have a higher rate of urbanization which create great pull factors for male migration from West Bengal. Maharashtra, Delhi and Jharkhand are the three most preferred destinations of male out-migrants from West Bengal whereas Jharkhand, Bihar and Uttar Pradesh are the three preferred destination places for female migrants from West Bengal.

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Undernutrition Level Among the Children Under 5 Years Age in Arsha Community Development Block of Purulia District, West Bengal

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Abstract : *Malnutrition is a serious concern for the world in general and for India in particular. Globally, there are 155 million children (22.9 per cent) under the age of 5 years affected by the stunting. The Millennium Development Goals (MDGs) of United Nations (UN) aimed to achieve 8 goals by 2015, of which the first goal was to 'eradicate the extreme poverty and hunger'. But all the goals were not fulfilled completely by the targeted year. Thus Sustainable Development Goals (SDGs) of UN (effective from January, 2016) adopts 17 global goals to be achieved by 2030 for the sustainable development of the world. The first 3 goals are 'no poverty', 'zero hunger' and 'good health and well-being'. Despite these programmes taken by UN and other organizations of the world of different capacities, we still experience the vicious cycle of poverty, hunger, malnutrition and diseases. In this backdrop, a field based study has been made in Arsha Community Development (C.D.) Block of Purulia district, West Bengal taking 148 children between the ages of 0 to 59 months to investigate the nutritional status of children. The World Health Organization's (WHO) "Child Growth Standards, 2006" are adopted for nutritional analysis of children. It is revealed from the study that the prevalence of underweight is found to be 67.57 per cent followed by stunting (63.51 per cent) and wasting (44.60 per cent). Female children are more at risk than the male children. The age groups of 24 to 35 and 12 to 23 months are more in vulnerable conditions than the other age groups. A large number of children i.e. 82.43 per cent are under the serious threat of undernutrition in the C.D. Block.*

Keywords : *Malnutrition, Stunting, Underweight, 0-59 months, Arsha C.D. Block.*

Introduction

The incidence of malnutrition happens to be a serious problem of developing countries in general and for India in particular. The undernutrition is an important contributor of high morbidity as well as mortality rate among children. Globally, there are 159 million stunted children under the age of 5 years, though the rate declined from 39.6 per cent in 1990 to 23.8 per cent in 2014. Moreover, there are 50 million wasted children worldwide, of which 16 million are severely stunted in 2014 (UNICEF, WHO and World Bank, 2015). Almost half of the deaths of children under 5 years

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of age is caused due to undernutrition. It brings the young children at a great risk of deaths, which may be resulted from common infections (www.unicef.org). To combat with these serious problems, many organisations of the world are trying their level best. In September 2000, 191 United Nations (UN) member states signed the *'Millennium Development Goals'* (MDGs), which include 8 goals for the world, to be achieved by the year 2015. All the nations were agreed and committed to fight against the poverty, hunger, illiteracy, environmental degradation, discrimination against women and diseases (www.who.int). This initiative yields success by rescuing millions of people from the paw of severe poverty, hunger, illiteracy and other things. But the work has not been completed within the time frame of 15 years. Still we have miles to go to eradicate these phenomena permanently. Thus, a new sustainable path was required to be chosen. In this context, the *'Sustainable Development Goals'* (SDGs) with its 17 global goals finally came in to being in January, 2016 by the UN in understanding of 170 countries of the world to obtain sustainable and better future for all. The main goals of SDGs are no poverty; zero hunger; good health and well-being; quality education; gender equality; clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation and infrastructure; reduced inequalities; sustainable cities and communities; responsible production and consumption; climate action; life below water; life on land; peace, justice and strong institutions; and partnerships for the goals. It has been targeted by the SDG to achieve each and every goal by 2030 (www.un.org; www.sustainabledevelopment.un.org; www.undp.org). But still now, the globalized 21st century has been experiencing the curses of poverty and hunger. According to the census of India 2011, about 68 per cent of Indian populations lives in rural areas, and majority of them take food below standard, stay at a poor housing condition, do not get the chance to come to higher education, activity of production is primitive and have a limited access to the new technological innovations. People living in a low economy and enjoying low standard of living are more prone to diseases and ill health directly or indirectly. It may be said that diseases promote poverty and poverty in turn breeds diseases. Society can only achieve a bench mark of development when its people enjoy a good health along with good quality of life; but quality of life and health status cannot be changed in a society overnight. Thus, the basic parameters of *'Human Development Index'* (HDI), such as health, education and income are required to be taken care in an integrated manner to bring any positive change (Sankar and Geetha, 2012). This stage will be attained if each and every individual gets adequate nutrition, proper education and an improved environment for all round development. It needs to be started with a child from its very first day of birth as the child in its growing period has a special requirement of nutrition, which requires to be fulfilled to achieve the optimum growth (WHO, 1995; Blosser et al., 2006).

In 2017, there were 151 million stunted children (22.2 per cent) and 51 million wasted children (7.5 per cent) in the world under the age of 5 years. In the case of Asia, the respective numbers of stunted, wasted and overweight children under 5 years of age were 83.6, 35.0 and 17.5 millions. It is quite unexpected that almost half of the world's stunted and overweight children under the age of 5 years lived in Asia in 2017. Two thirds wasted children of the same age group of the world also lived in Asia (UNICEF, WHO and World Bank, 2018). The National Family Health Survey-4 depicts

that in the case of India, the trends of mortality rate of infant and under 5 years aged children are 41 and 50 per 1000 live births respectively. The percentage of stunted children under 5 years of age is 38 and underweight is 36. In both cases, it is predominant among ST, SC and OBC castes children (NFHS-4, 2015-16). But in the case of South Asia, the prevalence of stunting in 2017 was 33.3 per cent, when the global percentage is 22.2 (UNICEF, WHO and World Bank, 2018). These values indicate towards the severity of malnutrition in India. In the case of Purulia of West Bengal the poor nutritional status of children in Jangalmahal areas is observed (Mandal and et al., 2017). To perceive the present situation of nutritional level among the children aged between 0 to 59 months, a study is carried out in Arsha Community Development Block (C.D. Block) of Purulia district, West Bengal. The specific objective of the study is to determine the prevalence of malnutrition in different villages of the C.D. Block.

Database and Methodology

This present study is completely based on primary survey, which is done based on a pre-tested structured questionnaire. The study is carried out in the months of December 2018 and January 2019 on 2 Gram Panchayats (GP), namely: Sirkabad and Beldih out of 8 GP (20 per cent of total GP). Finally, we have taken 4 villages (Senabana, Bandudih, Bhursa and Haranama) in total selecting 2 villages from each GP. The selection of GP and villages is made using random table number. According to the Census of India, 2011 there are 839 children within the age group of 0 to 6 years in these 4 villages (Census of India, 2011). A total number of 20 per cent sample will be taken into account for this study i.e. 168. But during the survey, only 148 children are found within the age group of 0 to 59 months. These children are included into the sample purposively, of which 80 are girls and 68 are boys. The status of nutritional level of children is done taking anthropometric measurements of them, such as height, weight and age. To measure the height and weight, a non-elastic measuring tape and normal weigh machine are used respectively. Age of the child is calculated from the birth certificate. In the case of non-institutional parturition (delivery at home), where the birth certificate is not available, the age of the child is noted based on the records of parents. The anthropometric measurements are then tabulated and calculated using the '*World Health Organization Child Growth Standards, 2006'* or the '*WHO standards, 2006'*. The WHO recommended parameters, such as *stunting* (Height-for-Age/HAZ), *wasting* (Weight-for-Height/WHZ), and *underweight* (Weight-for-Age/WAZ) are taken to assess the growth pattern of child and level of malnutrition. Z-scores are then computed for all these parameters using '*WHO-Anthro Software'* and '*Gaussian Curve'* is fitted to see the distribution (Onis et al., 2006; WHO, 2018; Namburi and Seepana, 2018). The classification of malnutrition is also done based on z-score values (Table: 1). Map of the C.D. Block is collected from 18th All India Livestock Census, Agriculture Implements & Machinary, Fishery Statistics, West Bengal (Govt. of West Bengal, 2007).

Arsha C.D. Block of Purulia District: The Area under Investigation

Arsha is one of the western C.D. Blocks of Purulia district, and surrounded by Purulia-I, Barabazar, Balarampur, Baghmundi and Jhalda-II C.D. Blocks. The geographical extensions of the

Table 1: Classification of malnourishment of children

Classification	Z-score values
Normal	-2 z-score to +2 z-score
Moderately malnourished	<-2 z-score to -3 ≤ z-score
Severely malnourished	<-3 z-score

Source: *WHO Child Growth Standards, 2006*

Arsha are 86°03'29.625"E to 86°21'19.159"E and 23°10'48.56"N to 23°23'06.365"N (Figure: 1). It belongs to the Sadar-West subdivision of Purulia district. The total households of the C.D. Block are 28,868 with a total population of 1,54,736 in 2011 (Census of India, 2011), which was 1,29,148 in 2001 (Census of India, 2001). It has an area of 375.04 km^2 with a population density of 413/km^2, where the average district population density is 468/km^2. Arsha does not possess any urban population. The percentage of male and female populations of Arsha in 2011 is 50.67 and 49.33 respectively. There are 18,294 (11.82 per cent) SC population, of which 9380 (51.27 per cent) and 8914 (48.73 per cent) are male and female respectively. The total ST population of Arsha is 33,568 (21.69 per cent). The total number of male and female populations is 16,777 (49.98 per cent) and 16,791 (50.02 per cent) respectively. The literacy rate of the C.D. Block is 54.78 per cent, of which male literacy rate is 70.36 per cent and female literacy rate is 38.75 per cent. A difference of 31.61 per cent of literacy rate is observed in between male and female populations. The total 0-6 years populations are 26,208 contributing 16.94 per cent of population to the total populations of the C.D. Block. The male and female populations are 13,193 (50.34 per cent) and 13,015 (49.66 per cent) respectively. The total workers of Arsha are 73,497 (47.50 per cent), of which cultivators, agricultural labourers, household workers and other workers are 19,904 (27.08 per cent), 30,374 (41.33 per cent), 9266 (12.61 per cent) and 13,953 (18.98 per cent) respectively (District Census Handbook, Puruliya, 2011). Arsha C.D. Block has only a Block Primary Health Centre (BPHC) and 2 Primary Health Centre (PHC). There are 44 beds available in these 3 health centres with the facility of 4 doctors. There is only a family welfare centre situated in the C.D. Block. In 2014 there were 323 children of different age groups died in Arsha, of which 5 and 318 children died up to the age of 5 years and above 5 years respectively. The C.D. Block has 134 primary schools, 16,636 students, 323 teachers; 19 upper primary schools, 2058 students, 48 teachers; 1 secondary schools, 653 students, 14 teachers; 9 higher secondary schools, 13,238 students, 215 teachers; 1 college, 1056 students, 14 teachers; professional and technical school/college 1, student 12, teacher 7; 226 special and non-formal education institutions, 8614 students and 231 teachers. Besides these, all the 96 mouzas of the C.D. Block enjoy the drinking water facility. Only 3 mouzas are not electrified in 2014 (District Statistical Handbook, Purulia, 2014).

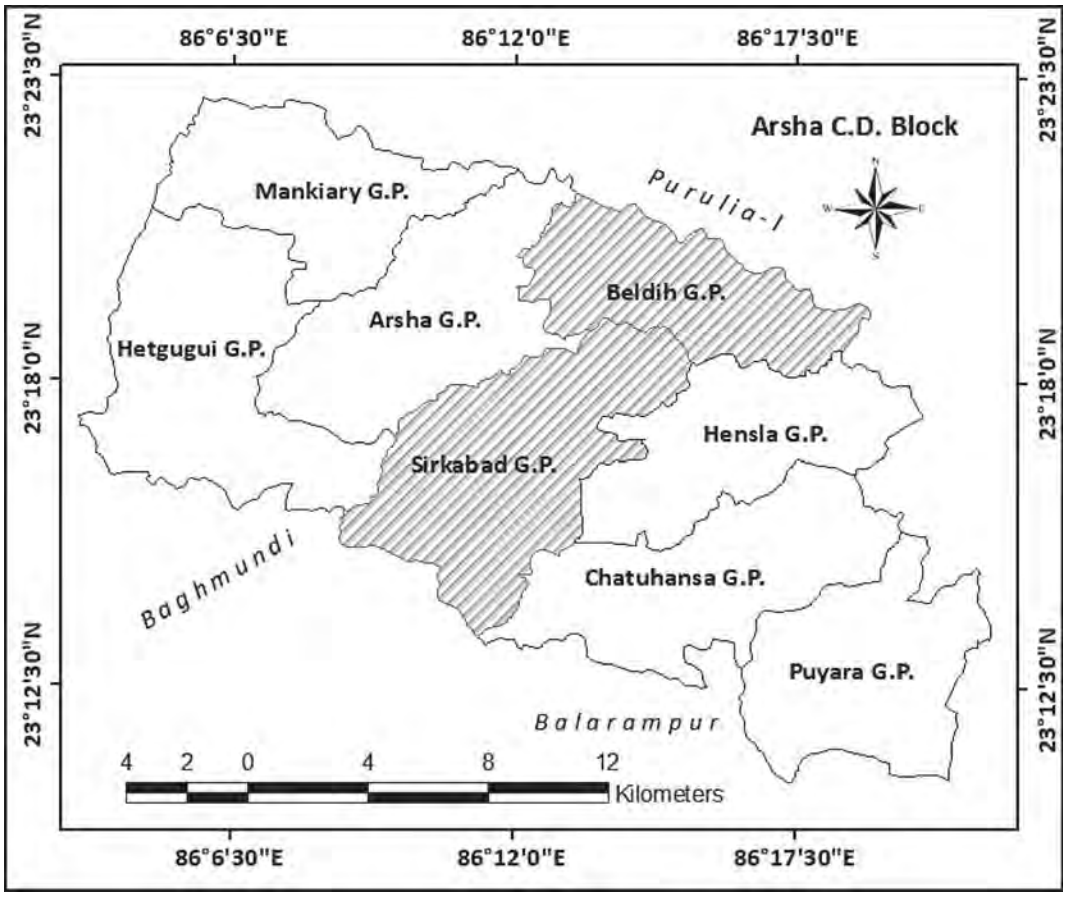

Fig. 1: Map of Arsha C.D. Block

Results and Discussion

There are 26,208 children within the age group of 0 to 6 years at Arsha C.D. Block. It is good to find that there are 1014 female children per 1000 male children (Census of India, 2011). We find the ratio during our study in 4 selected villages of Arsha as 1176 female children per 1000 male children below the age of 5 years. This is a good signature for girl populations. The concentration of female children is found to be higher in the age groups of 48 to 59, 36 to 47 and 24 to 35 months. In the case of male children, they are almost evenly distributed across all the age groups (Figure: 2).

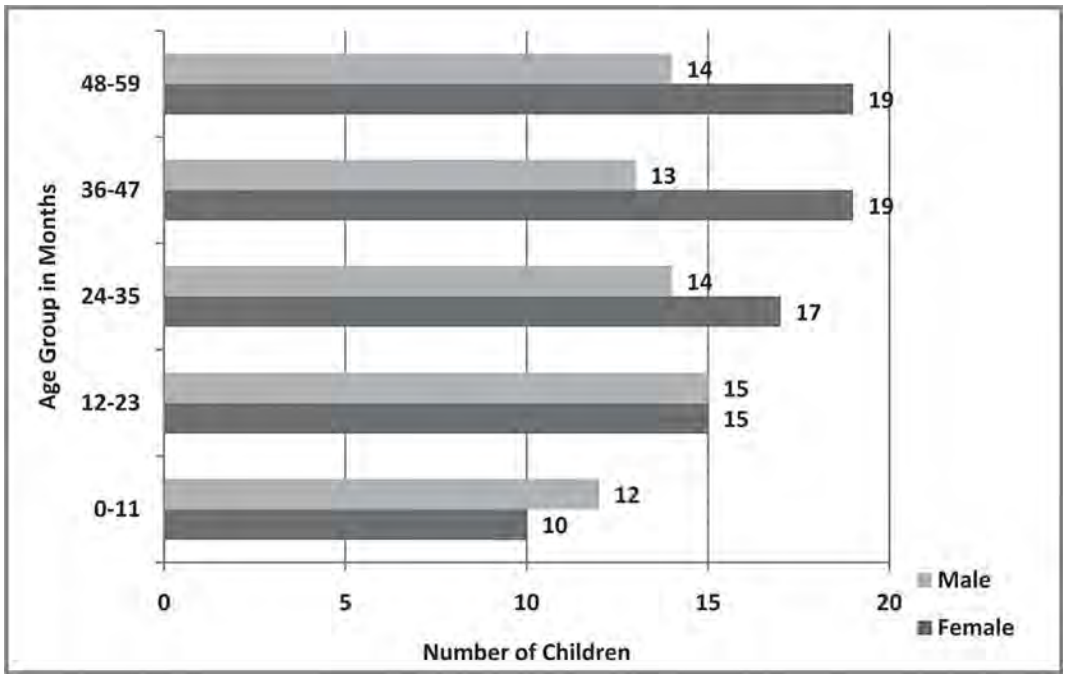

Fig. 2: Age and sex wise distribution of children

Source: *Primary database,Year*

Prevalence of Stunting (HAZ Scenario)

The word stunting refers to a particular state when a child cannot attain sufficient height in a specific age. In other words, a child is too short to her or his age. Stunting in a child may result from poor nutritional intake in-utero and in early childhood. It may restrict the physical and cognitive growths and developments of a child. The condition of stunting may last for whole life, and future generations of the child can also be affected with this. This is a serious global concern (UNICEF, WHO and World Bank, 2018). Our study reveals that the prevalence of stunting among children is 63.51 per cent, of which the percentages of male and female children are 60.29 and 66.25 respectively. Severe form of stunting is observed to be 33.78 per cent, which is quite alarming. Female children are more likely to be affected by the stunting, especially by severe stunting, than the male children (Table: 2). The figures: 4 and 5 also show that the distribution curves are more negatively skewed in both the cases of male and female children. Severity of stunting is observed as 20.21 per cent for the age group of 24 to 35 months followed by the 12 to 23 months (10.64 per cent). These two age groups are more exposed to stunting (Figure: 3).

Table 2: Prevalence of stunting based on height-for-age z-score

Category of Stunting	All N= 148	Male Children n= 68	Female Children n= 80
Prevalence of Stunting (<-2 z-score)	94 (63.51 per cent)	41 (60.29 per cent)	53 (66.25 per cent)
Prevalence of Moderate Stunting (<-2 z-score to -3 ≤ z-score)	44 (29.73 per cent)	20 (29.41 per cent)	24 (30.00 per cent)
Prevalence of Severe Stunting (<-3 z-score)	50 33.78 per cent	21 (30.88 per cent)	29 (36.25 per cent)

Source: *Computed by authors, 2018-19*

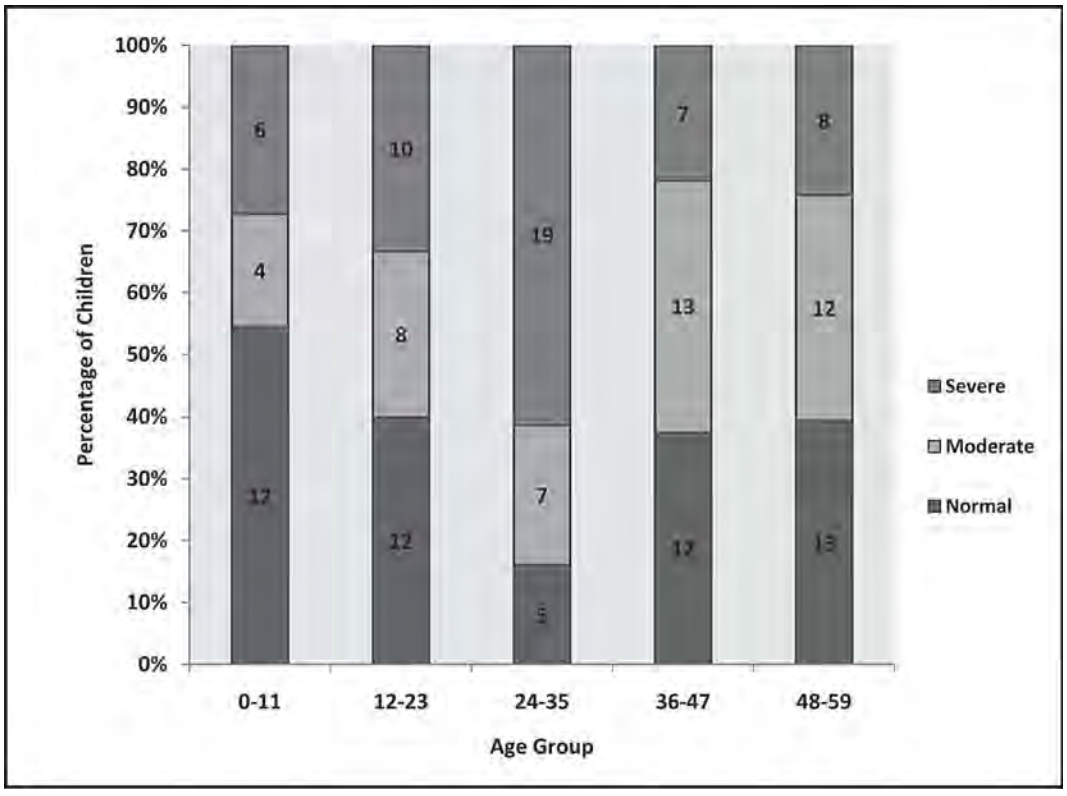

Fig. 3: Age wise prevalence of stunting among children

Prevalence of Wasting (WHZ Scenario)

Wasting refers to such a situation when a child fails to achieve sufficient weight for height. Weight for height is basically used as an indicator of current nutritional status. It is caused due to

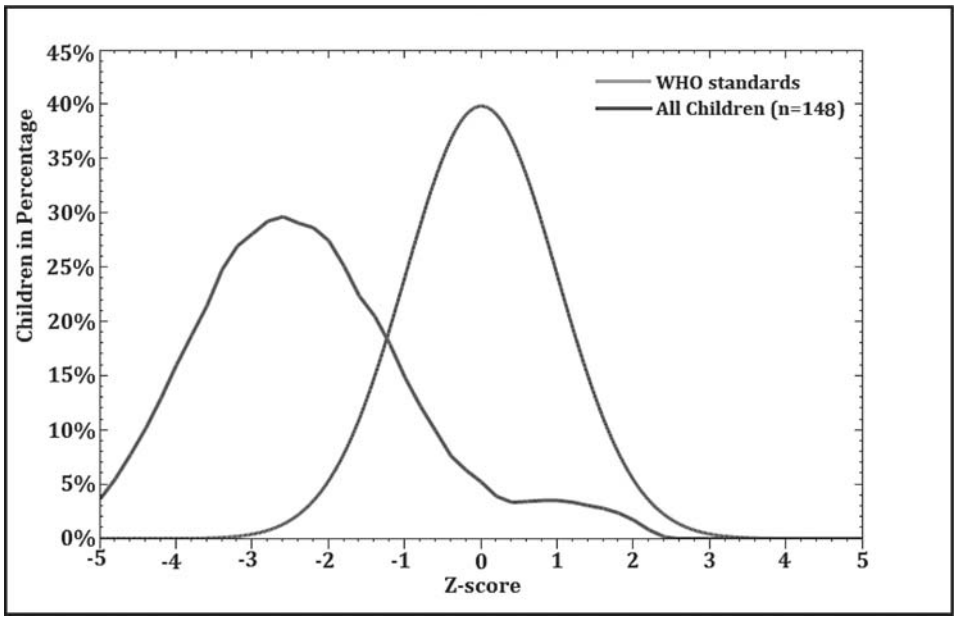

Fig. 4: Height-for-age z-score of children

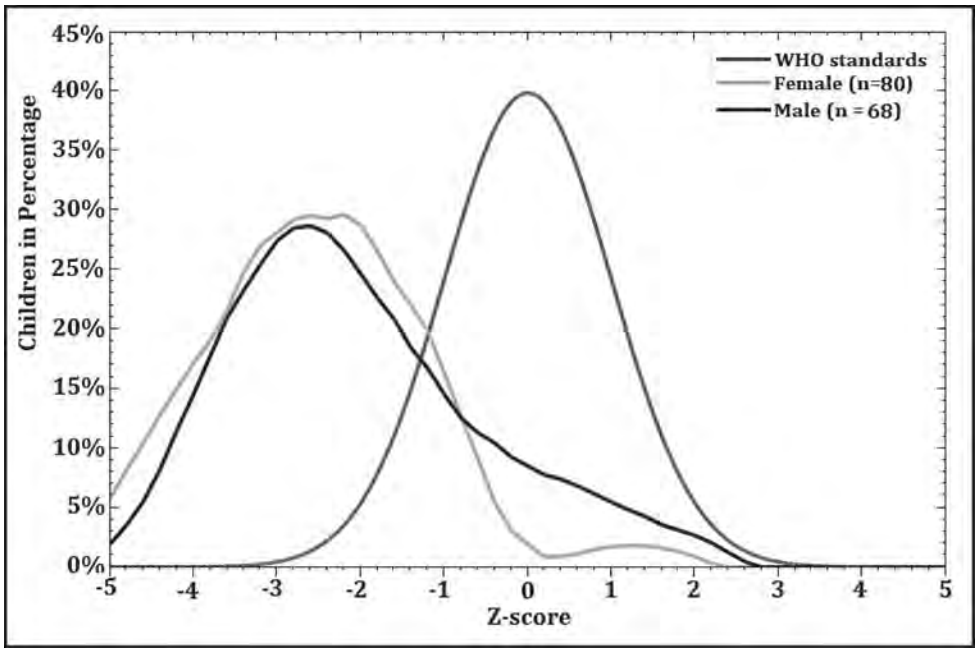

Fig. 5: Sex wise height-for-age z-score of children

poor nutrient intake for a long period of time. The wasted children may face the low immunity power, delayed physical and brain development and even death also. Children experiencing this particular problem need urgent feeding and immediate medication (UNICEF, WHO and World Bank, 2018). The occurrence of wasting in our present study area is found to be significant with a value of 44.60 per cent, but it is less prevalent than the stunting. The respective percentage of wasting for male and female children is 42.65 and 46.25. Prevalence of severe wasting is observed to be 22.30 per cent, where male children are 27.94 per cent and female children are 17.5 per cent. The results speak that the female children suffer more in case of wasting than the male children in general, but the severe form of wasting is more experienced by the male children (Table: 3). The distribution curves also state the same fact (Figure: 7 & 8). It is found from figure: 6 that the age group of 12 to 23 month is more severely wasted (18.18 per cent) followed by the 24 to 35 months (13.64 per cent). In contrast, the age group of 0 to 11 months is in better condition compared to other age groups.

Table 3: Prevalence of wasting based on weight-for-height z-score

Category of Stunting	All N= 148	Male Children n= 68	Female Children n= 80
Prevalence of Wasting (<-2 z-score)	66 (44.60 per cent)	29 (42.65 per cent)	37 (46.25 per cent)
Prevalence of Moderate Wasting (<-2 z-score to -3d" z-score)	33 (22.30 per cent)	10 (14.71 per cent)	23 (28.75 per cent)
Prevalence of Severe Wasting (<-3 z-score)	33 (22.30) per cent	19 (27.94 per cent)	14 (17.5per cent)

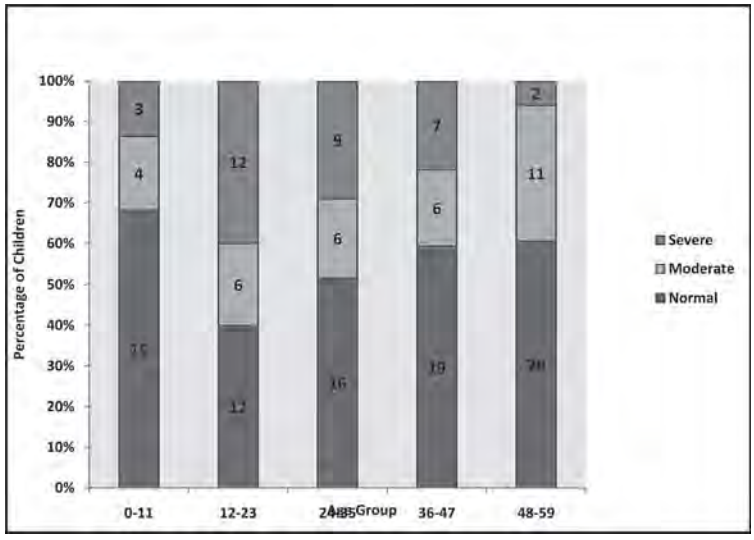

Fig. 6: Age wise prevalence of wasting among children

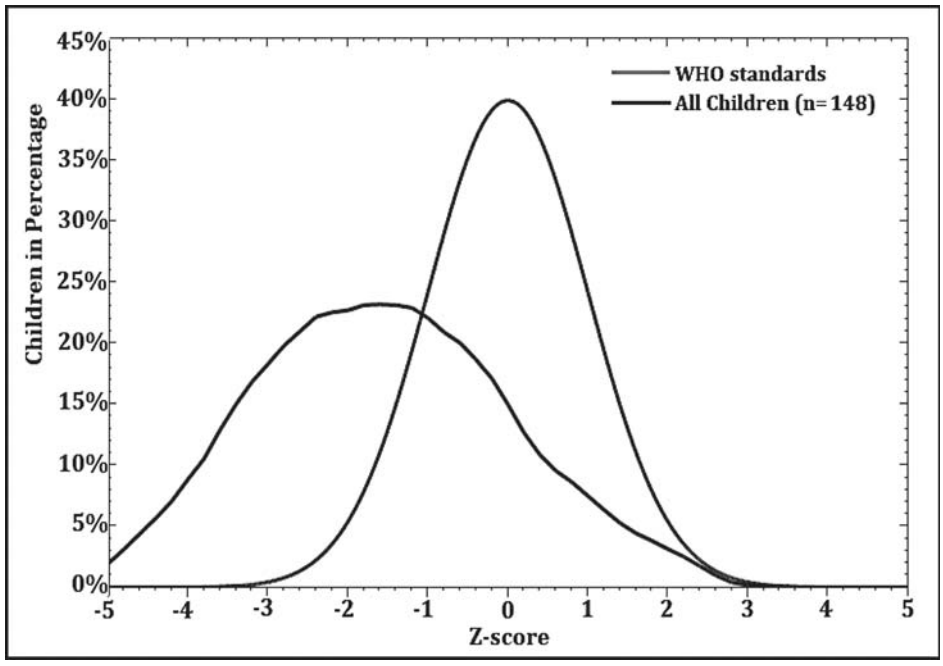

Fig. 7: Weight-for-height z-score of children

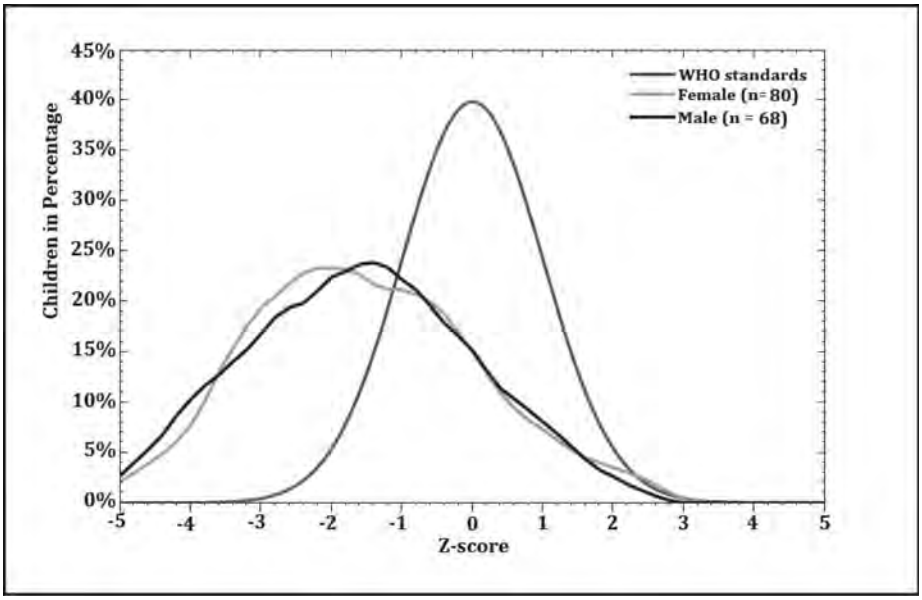

Fig. 8: Sex wise weight-for-height z-score of children

Prevalence of Underweight (WAZ Scenario)

It is a situation when a child's weight is less than expected of his/her age. It is mainly caused by the lack of nutrients supplied by the dietary or diseases (NLIS, 2010). It was estimated by the UNICEF, WHO and World Bank that there were 99 million children under the age of 5 years underweight globally. But the global trend was declining, as it was 25 per cent in 1990 and 15 per cent in 2013. In this period of time, Asia reduced this from 32 per cent to 18 per cent (UNICEF, WHO and World Bank, 2015). This trend is definitely appreciable for the continent. In case of our study, it portrays different picture than the scenario of Asia as reported by the UNICEF, WHO and World Bank in 2015. We find that a large proportion of children (67.57 per cent) under the age of 5 years are underweight, of which 63.24 per cent is male children and 71.25 per cent is female children. Prevalence of moderate underweight is high among the female children (30 per cent); whereas, male children experience severe underweight (44.12 per cent) than the rest (Table: 4). It is important to

Table 4: Prevalence of underweight based on weight-for-age z-score

Category of Underweight	All N= 148	Male Children n= 68	Female Children n= 80
Prevalence of Underweight (<-2 z-score)	100 (67.57) per cent	43 (63.24) per cent	57 (71.25) per cent
Prevalence of Moderate Underweight (<-2 z-score to -3 ≤ z-score)	37 (25.00) per cent	13 (19.12) per cent	24 (30.00) per cent
Prevalence of Severe Underweight (<-3 z-score)	63 (42.57) per cent	30 (44.12) per cent	33 (41.25) per cent

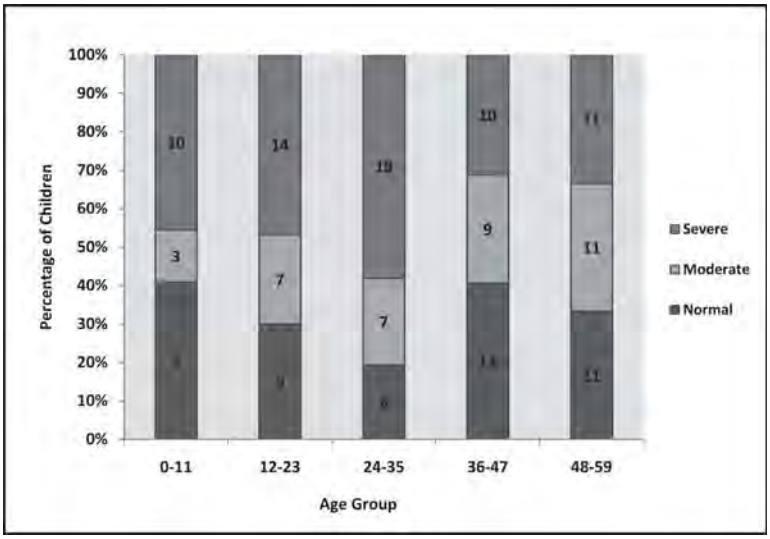

Figure 9: Age wise prevalence of underweight among children

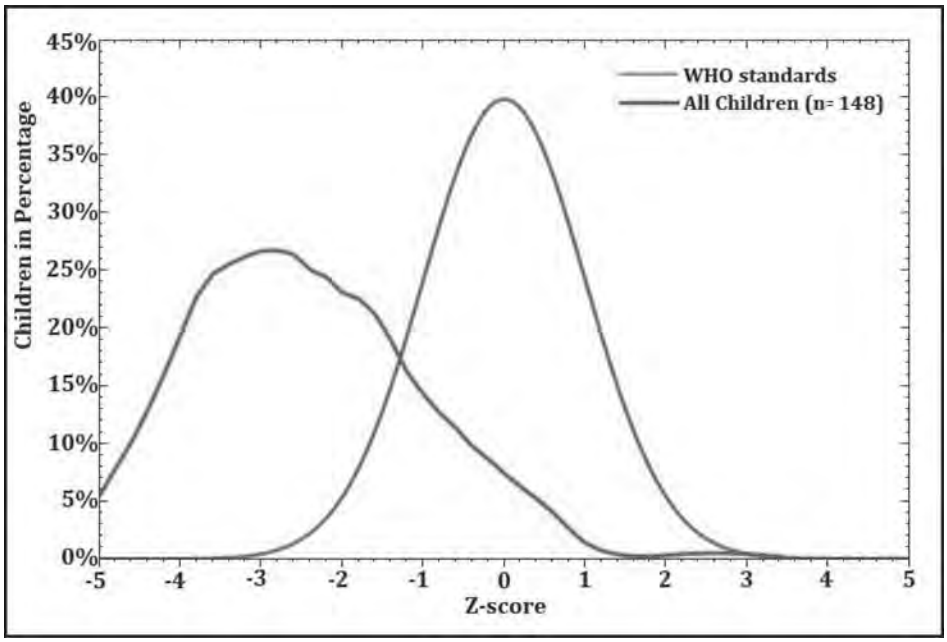

Figure 10: Weight-for-age z-score of children

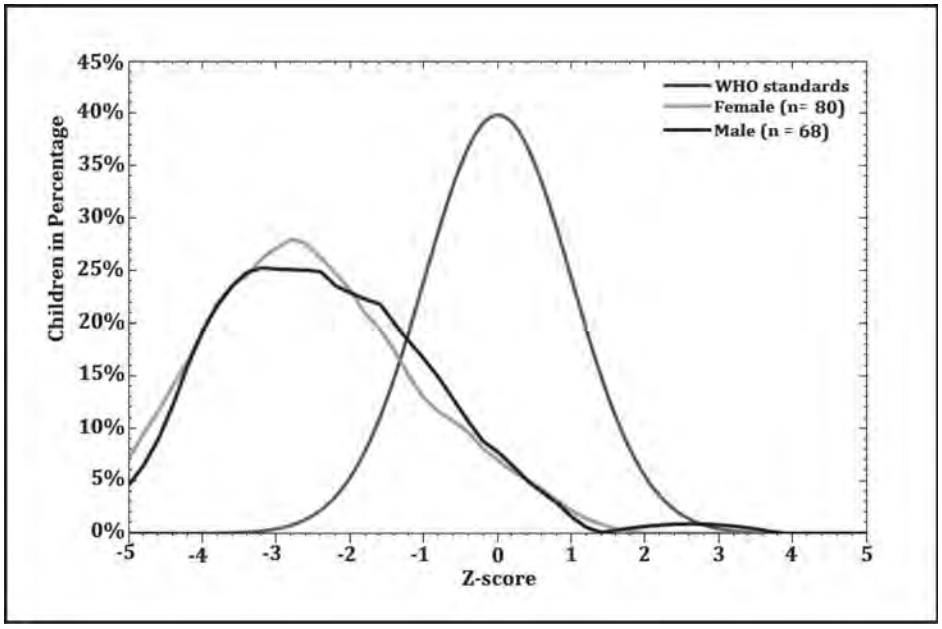

Figure 11: Sex wise weight-for-age z-score of children

note that the female children are more in vulnerable condition than the male children in the case of underweight. The study also reveals that the age groups of 24 to 35 months and 12 to 23 months face severe form of underweight as 18 per cent and 14 per cent respectively (Figure: 9). The frequency distribution curves also show the same patterns (Figure: 10 & 11).

Table 5: Category and sex wise prevalence of malnutrition among children

	Category	Total	Male Children	Female Children
Normal	Normal	26 (17.57%)	12 (17.65%)	14 (17.50%)
Undernutrition	Stunting	18 (12.16%)	11 (16.18%)	7 (8.75%)
	Wasting	4 (2.70%)	2 (2.94%)	2 (2.5%)
	Underweight	3 (2.03%)	0 (0%)	3 (3.75%)
	Stunting & Wasting	0 (0%)	0 (0)	0 (0)
	Stunting & Underweight	35 (23.65%)	15 (22.06%)	20 (25.0%)
	Wasting & Underweight	21 (14.19%)	13 (19.12%)	8 (10.0%)
	Stunting, Wasting & Underweight	41 (27.70%)	15 (22.06%)	26 (32.5%)
	Total of Undernourished Children	**122 (82.43%)**	**56 (82.35%)**	**66 (82.5%)**
All Total		**148 (100%)**	**68 (100%)**	**80 (100%)**

Overall Malnutrition Scenario

There are millions of children under the age of 5 years suffering from malnutrition worldwide. This is an emergency situation almost for all nations. It is reported that two out of five stunted children are found to be living in South Asia in 2016, which is quite unfortunate (UNICEF, WHO and World Bank, 2017). Our study unveils the malnutrition scenario of the Arsha C.D. Block in present day. Only 17.57 per cent children under the age of 5 years found not to be undernourished. The prevalence of a specific condition of undernutrition, such as stunting, wasting and underweight is observed among the children in very low proportions (Table: 5). Actually more than one state of undernutrition is found to be prominent among the children, which is a serious concern. The category of stunting, wasting and underweight contributes 27.70 per cent undernutrition among the children followed by the stunting and underweight (23.65 per cent), wasting and underweight (14.19 per cent) and stunting (12.16 per cent) categories. Overall 82.43 per cent children are under the risk of undernutrition, of which male and female children are 82.35 and 82.50 per cent. There is no significant variation of prevalence of undernutrition observed between male and female children. So, sex has no role in prevalence of malnutrition in our study area.

Conclusion

Malnutrition is the curse to the world. A child born today is the future of tomorrow, and a nation cannot prosper with malnourished citizens. Nutritional care at the early age of childhood can stop the risk of diseases and deaths of children. A balance diet, if supplied to the children or any individual in regular basis can only bring the difference in any society. Ill-fed and ill-health populations will not be able to contribute to the society for a long time. In the case of Arsha C.D. Block of Purulia district, it is found that the prevalence of underweight children (67.75 per cent) followed by stunting (63.51 per cent) is predominant. Female children are observed to be more undernourished than the male children in general (Table: 4 & 3). The age groups of 24 to 35 months and 12 to 23 months under 5 years children are found to be more vulnerable in the cases of stunting, wasting and underweight than the other age groups of children. The category of stunting, wasting and underweight dominates most (27.70 per cent) compared to other categories of undernutrition. Overall prevalence of undernutrition in the C.D. Block is observed to be 82.43, of which male children are 82.35 per cent and female children are 82.5 per cent. These values indicate towards the inadequate nutrient supply to a child during prenatal and postnatal periods (Table: 5). Our study disclose the present scenario of the nutritional status of children living in Arsha as well the situation of the Purulia district in the context of MDGs and SDGs of UN.

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Spatial Concentration of Urban Infrastructural Facilities: A Case Study of Berhampore Town, West Bengal

Mustafijur Rahaman[1] and Nigar Alam Siddique[2]

Abstract : *Infrastructure plays a vital role in the process of urbanization and urban change. The major concern in the present time is the growing gap between the demand and provision of basic institutional facilities such as education, health, drinking water, sanitation, etc. The demand for various facilities increases with population growth and the old facilities have to be upgraded with rising living standard and public expectations. The present study tried to focus on a quantitative approach to educational facilities, health facilities, economic facilities, and other facilities. The quantitative method like Location Quotient, Average ward-wise composite score, composite indicators are applied to design the whole research work. Some problems related to lack of facilities are identified, and solutions to these problems are also recommended in this paper. Besides, a plan for the development of urban infrastructure related to education, health and economy are discussed in this research.*

Keywords : *Town, facility, Composite Score, Berhampore, West Bengal.*

Introduction

Infrastructure is critical in the process of urban change in a certain way. The story of infrastructure is the story of civilization. As people began to civilize since they initiated constructed features within an urban space. Urban infrastructural facilities are the essential services which are important for the daily life of urban people. These facilities are related to the social & economic development of the area concerned. Rapid population growth in urban areas of the developing world leads to growing deficits of urban facilities in terms of quality and quantity. There is a great challenge in maintaining services and extending them to deprived areas. Civic and basic urban necessities provided by a municipality are important components of a city which play a meaningful role in determining the quality of any urban settlement. Urban infrastructural facilities are the essential services which are important for the daily life of urban people. The Investments for the

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development of infrastructure and provision of essential services have not been spatially balanced during the past few decades. Urban governments play an important role in the provision of urban infrastructural facilities, and they have a significant impact on city development.

Dhaliwal, S. (2004) discussed on that urban infrastructural development in small and medium town. His observation of the study is the growth of urban population in India during the past decade indicates higher growth for metro cities. However, he emphasized that the development of basic infrastructural services like education facilities, water supply, health facilities, sanitation facilities, solid waste management, and transportation could not keep pace with the growth of urban population. He also described that the municipal government plays a vital role in the provision of urban services and they have a significant impact on city development. Rapid population growth in urban areas of the developing world leads to growing the urban facilities deficits both in terms of maintaining services and extending them to sub-serviced areas. Borana, S.L. & Yadav, S.K. (2017) analyzed the spatial distribution disparity analysis of urban amenities in Municipal Ward's periphery of Jodhpur city. From their studies it enlightened urban amenities comprises the infrastructure, goods, and services that are very much needed. They utilized the Landsat 2015 data and designed the study by Arc GIS. Also, they used the Lorenz curve to showing the disparities. URDPFI norms also have been used to verify the discrepancies. For displaying the magnitude of facilities, they utilized the buffer map in their study. In study area is seen the uneven distribution of urban amenities.

Selection of the Study Area

Berhampore town is the district headquarters where higher order administrative functions are performed, and higher order infrastructures render services to the people. Berhampore is a city in the West Bengal state of India. Berhampore is the sixth largest city in West Bengal (after Kolkata, Asansol, Siliguri, Durgapur, and Malda) and situated in the central part of West Bengal. Berhampore town is located just beside Bhagirathi River and nearer to NH-34. The total population of Berhampore town as per 2011 census is 195225, and the area covered 22.67 sq. Km. 34. The geographical extension of Berhampore town is 24º 62 N, 88º 152 E. There are 25 wards in the town. According to Census of India, 2011 the urbanization of West Bengal percentage is 31.87. The rate of urbanization is acceleration in way. Only one large town i.e. Kolkata metropolitan city is located in west Bengal. This city is composed high concentrations of facilities like, education, health, economic and others. But in a small town, most of the peoples are faced problems due to lack of facilities. The people of the every corner of West Bengal are fully dependent on the Kolkata metropolitan town in terms of facilities. They are compelled to go there. Berhampore town is small and having unequal concentration of infrastructural facilities. Also lack of infrastructural facilities is one of the salient features of the study area.

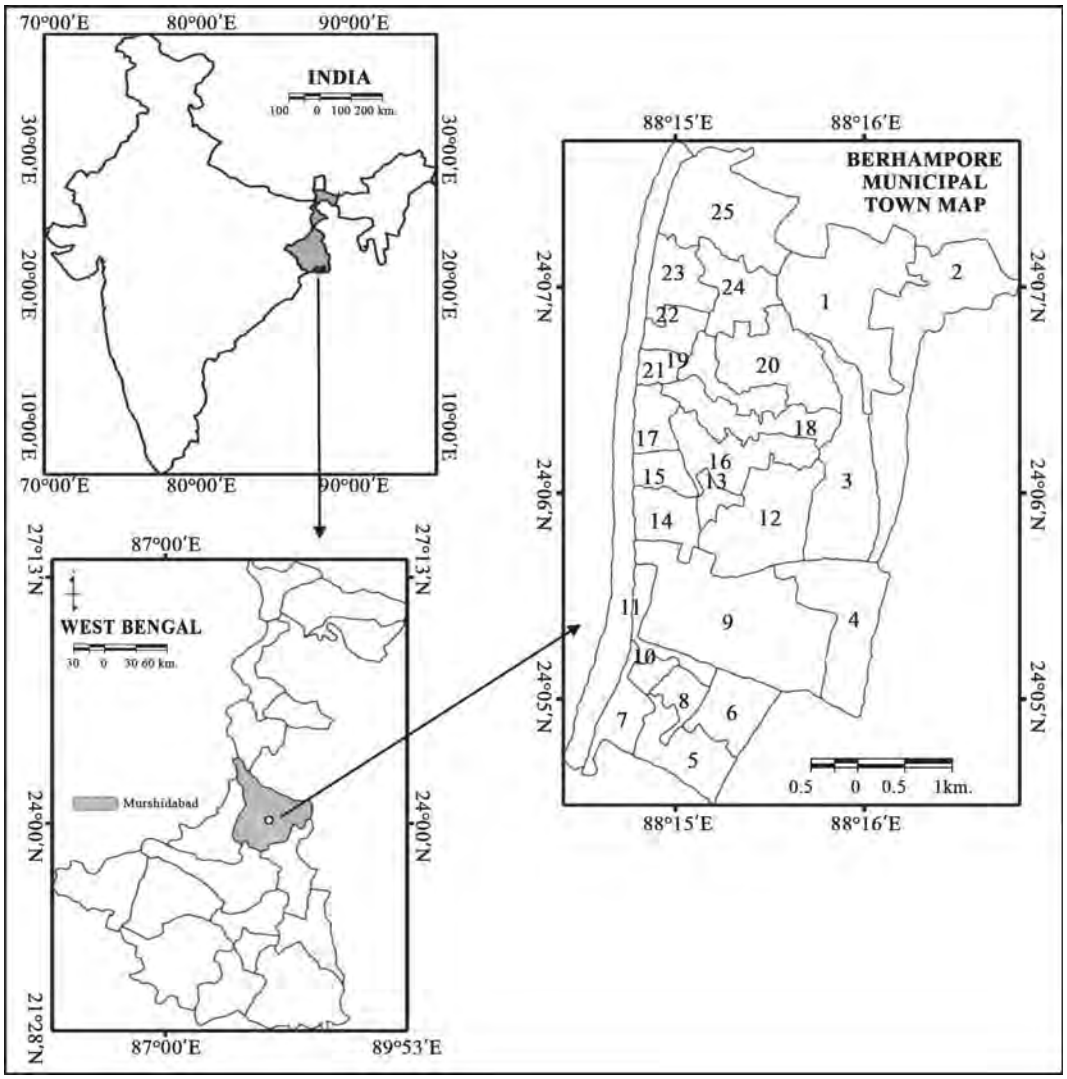

Fig. 1 Location Map of the Study Area

Objectives

The main objectives of the present study are to analyze the infrastructural facilities. The objectives of the study are as follows:

- To find out the spatial pattern of distribution of infrastructural facilities in different wards of the town.

- To analyze the level of concentrations of infrastructural facilities throughout the study area.
- To calculate the Municipal Composite Score (MCS) and Average Ward Wise Composite Score (AWCS) of infrastructural facilities in Berhampore town.

Database and Methodology

This study is mostly based on secondary data which has been collected from various govt. sources like Berhampore Municipality, Department of Deputy Inspector of Schools, Health Departments of Berhampore Municipality and license dept. of Municipality. The data concerning population, road, location of cinema halls, auditorium, parks, police station, bus stop, bus stand, electric office, market, etc. are collected from different departments of Berhampore Municipality. Some tools are used for data interpretation which is as under:

1. The ***'Location Quotient'*** formula has analyzed the spatial variation of concentration of urban infrastructural facilities.

   Location Quotient (L.Q): L.Q= (Xi/Ni)/(X/N)

   Where,

   Xi=no. of facility in a given ward

   Ni=Population of each ward

   X= no. of total facilities in the municipality

   N=Total population of the municipality.

2. ***Average Ward-Wise Composite Score:*** (After Paul and Dasgupta)

   F.C.I. (Facility Composite Indicator)

   {(Facility percentage in wards / ward population) ×10000} ÷

   {(Facility percentage in municipality/total population) ×10000}

   M.C.I. (Municipality Composite Score) = " (F.C.I.1 + F.C.I.2 + F.C.I.3 + ……. F. C. I .n)

   A.W.C.S. (Average Ward-Wise Composite Score): MCI / Total Number of Facility

Results and Discussion

In the present paper, the level of concentration of facilities has been calculated in terms of the population size of each ward. Here to calculate the location quotient of different facilities, all the 35 facility indicators has been classified into four broad categories such as a bank, credit institutes, ATM, etc. have been kept under Financial Facilities category. In the same way primary, secondary, higher secondary, colleges and universities have been held under the Educational Facilities category. Hospital, Nursing Home, etc. have been kept under the category of Health Facility. Rest of the facilities like market, hotels, post office, bus stand, rail station, playground, drinking water supply

lighting, etc. have been indicated as Other Facility. For the calculation of L. Q values the different type of facility concentration zones has been selected (Table -1).

Table 1: Average Ward –wise Composite Score of Facility Services in Berhampore Town

Ward No.	Status of Educational Infrastructure Facilities	Status of Health Infrastructure Facilities	Status of Economic Infrastructure Facilities	Status of Other Infrastructure Facilities	Total Score of Facility-Utility	Average Ward–wise Composite Score
WARD 1	1.72	0.00	0.00	2.80	4.52	0.1291
WARD 2	8.52	3.24	3.37	0.00	15.13	0.4323
WARD 3	1.63	4.37	2.27	3.16	11.43	0.3266
WARD 4	1.15	10.525	0.59	0.00	12.265	0.3504
WARD 5	0.91	14.57	1.87	11.14	28.49	0.8140
WARD 6	1.29	7.32	2.64	2.98	14.23	0.4057
WARD 7	2.22	4.46	0.76	10.6	18.04	0.5154
WARD 8	1.90	0.00	0.00	0.00	1.90	0.0542
WARD 9	9.94	23.66	27.51	22.80	83.91	2.3974
WARD 10	1.06	0.00	1.09	5.27	7.42	0.2120
WARD 11	10.33	14.8	0.95	0.00	26.08	0.7451
WARD 12	1.78	18.78	6.52	23.49	50.57	1.4448
WARD 13	0.96	10.84	9.67	2.86	24.33	0.6951
WARD 14	0.49	12.42	1.94	6.11	20.96	0.5988
WARD 15	5.76	3.39	1.48	0.00	10.63	0.3037
WARD 16	2.18	6.38	5.24	4.04	17.84	0.5097
WARD 17	3.14	8.42	13.5	3.70	28.76	0.8277
WARD 18	2.43	0.00	0.00	0.00	2.43	0.0694
WARD 19	1.22	0.00	7.68	1.59	10.49	0.2997
WARD 20	1.14	1.78	0.39	1.00	4.31	0.1231
WARD 21	3.76	0.00	0.00	1.66	5.42	0.1548
WARD 22	4.38	0.00	0.82	5.30	10.50	0.3000
WARD 23	3.57	7.42	0.00	0.00	10.99	0.2354
WARD 24	2.36	0.00	0.53	5.35	8.24	0.2354
WARD 25	1.88	2.08	0.46	1.17	5.59	0.1597

Source: Calculated by the Authors based on the data from Department of Urban Planning, Berhampore Municipality, 2018

Educational Facilities

In Berhampore town there are many educational institutions for primary to graduate level studies. There are seen 42 primary schools, the no. of high school (Secondary and higher secondary School) is 19, among them one is special education school and six colleges including one girl's college and one B.Ed. College. But there has no university though it is the headquarters of the district. However, the spatial concentration of education facilities (Table 2) in the concerned town is proved that very high concentration of education is seen in wards such as 2, 9, 11, 15 and 22. Here, Deficient concentrations are stretched in Ward No.5, 13 and 14. (Figure 2)

Table 2: Spatial Concentration of Educational Facilities

Spatial Concentration Zone	L.Q. Values	Ward No.
Very High	Above 4.00	2,9,11,15, 22
High	3.00-4.00	17, 21, 23
Moderate	2.00-3.00	7,16,18,24
Low	1.00-2.00	1,3,4,,6,8,10,12,19,20,25
Very Low	Below 1.00	5,13,14

Source: Data calculated by the authors, 2018

Health Facilities

Health is the most crucial indicator of human development as well as enriches urban well-being. In the study area, there are six hospitals out of it one is Murshidabad Medical College Hospital, and three government hospitals are also found there. One mental hospital is there in ward no. 14. In the town, there are 16 nursing homes as well as many diagnostic centers. Berhampore Municipality controls and runs eight primary health centers for free treatment of slum dwellers. (Table 3)

Table 3 Spatial Concentration of Health Facilities

Spatial Concentration Zone	L.Q. Values	Ward No.
Very High	Above 8.00	4,5,9,11,12,13,14
High	6.00-8.00	6,17,23
Moderate	4.00-6.00	3,7,16
Low	2.00-4.00	2,15,25
Very Low	Below 2.00	1,8,10,18,19,20,21,22,24

Source: Data calculated by the authors, 2018

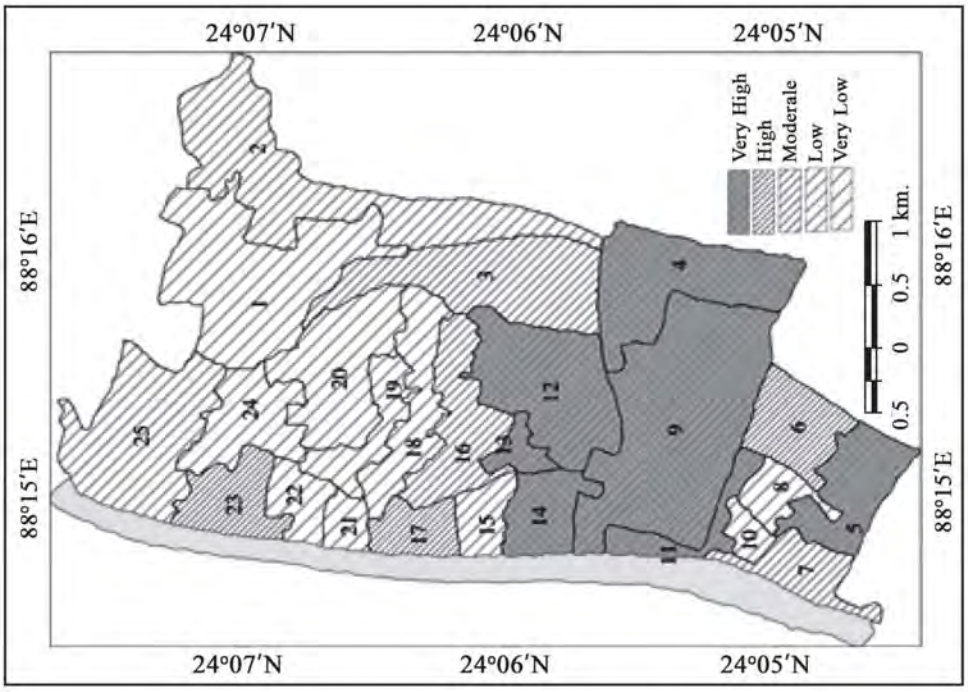

Fig. 3: Spatial Concentration of Health Facilities

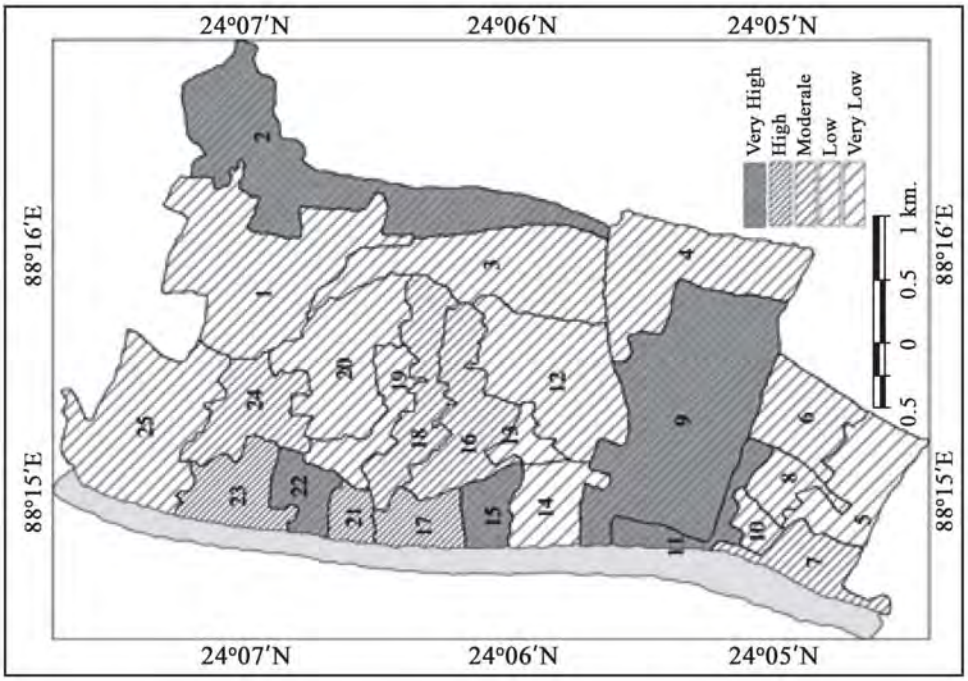

Fig. 2: Spatial Concentration of Educational Facilities

In terms of spatial concentration of health facilities in town is observed that very high concentration of health is Ward No. 4, 5, 9, 11, 12, 13 and 14 as this is the heart of the town and CBD zone of the study area. Low concentration is seen in Ward No.1, 8, 10, 18, 19, 20, 21, 22 and 24. Many wards belong to low health facilities in the town. Remaining Wards are including moderating in condition. (Fig. 3)

Economic Facilities

Economic facilities are a crucial variable which mentions the nature of financial setup in the town. Hence, facilities also meet up the regular finance needs of the local people and different commercial sectors. So for the economic growth are mostly depending on these institutions. In the study area, 11 private banks, ten national banks, 41 ATM, two corporation banks and two credit institutions are privileged throughout the town. (Figure 4) Inwards such as 5, 7, 9, 10, 12, 14, 22, 24 are seen with a very high concentration of financial setup. Among them, CBD ward nine is arrayed with all types of financial institutions. The very low concentrations of various economic facilities are instructed in the wards 2, 4, 8, 11, 15, 18, 20 and 23. The owing wards in town are liked as moderate in facilities concentrations (Table 4).

Table 4: Spatial Concentration of Economic Facilities

Spatial Concentration Zone	L.Q. Values	Ward No.
Very High	Above 4.00	9,12,13,16,17,19
High	3.00-4.00	2
Moderate	2.00-3.00	3,6
Low	1.00-2.00	5,10,14,15
Very Low	Below 1.00	1,4,7,8,11,18,20,21,22,23,24,25

Source: Data calculated by the authors, 2018

Other Infrastructural Facilities

The total 16 indicators are grouped under other infrastructural facilities. (Figure 5) Police Station, Bus stand, Rail station, Post office, Water connection, Public urinals, Cinema hall, playground, club, hotel, petrol pump, cold storage, market, burning ghat, street light all are determined for the present study. In town Clubs are 16, hotels are 21, Petrol pumps are 2, cold storage is 1, Burning Ghats are 2, the burial ground is 1 and 14 markets are seen there. Very high concentrations facilities are observed in the wards such as 5, 7, 9, 10, 12, 14, 22 and 24. Besides, many wards, i.e., 2, 4, 8, 11, 15, 18, 20 and 23 are including to shallow type of facilities in the concern study area. Other than, remaining wards are selected as moderate concentration for infrastructural facilities. (Table 5)

Table 5: Spatial Concentration of Other Infrastructural Facilities

Spatial Concentration Zone	L.Q. Values	Ward No.
Very High	Above 4.00	5,7,9,10,12,14,22,24
High	3.00-4.00	3,16,17
Moderate	2.00-3.00	1,6,13
Low	1.00-2.00	19,21,25
Very Low	Below 1.00	2,4,8,11,15,18,20,23

Source: Data calculated by the authors, 2018

Average Ward-Wise Composite Score

In the present study, four critical variables have been selected which are educational facilities, health facilities, commercial facilities and other infrastructural facilities for measurement the average ward-wise composite score of Municipality. From the calculation by spatial concentration (Table 6) of Municipality Composite Index (MCI), it has been very much identified that very high concentration is seen inward no.5, 9, 12 and 17. All types of facilities are located in these wards in the town. Besides, very low concentration is found in wards 1, 8, 18, 20, 24 and 25. Remaining wards belong to a moderate class of concentration. (Figure 6)

Table 6 Spatial Concentration of Average Ward Wise Composite Score

Spatial Concentration Zone	L.Q. Values	Ward No.
Very High	Above 0.80	5,9,12,17
High	0.60-0.80	11,13
Moderate	0.40-0.60	2,6,7,14,16
Low	0.20-0.40	3,4,10,15,19,22,23,24
Very Low	Below 0.20	1,8,18,20,24,25

Source: Data calculated by the authors, 2018

Conclusion and Recommendations

In this study of urban infrastructural facilities, the unequal distribution of infrastructure is seen throughout the town. A high concentration of urban infrastructure facility is found in outskirts of CBD region followed by the surrounding wards of the municipality. The periphery regions are identified as moderate to a low level in terms of institutional concentration. There are four colleges in the study area but it does not have a single university for higher education. There is one medical college and hospital in the town, but it lack in terms of the availability of primary health centers

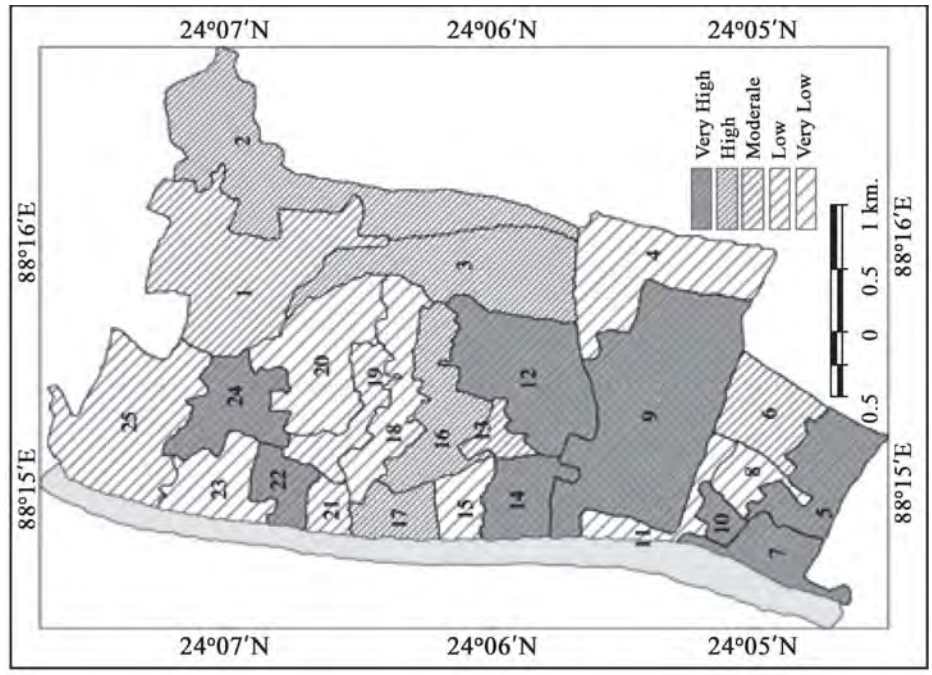

Fig. 5: Spatial Concentration of Other Infrastructural Facilities

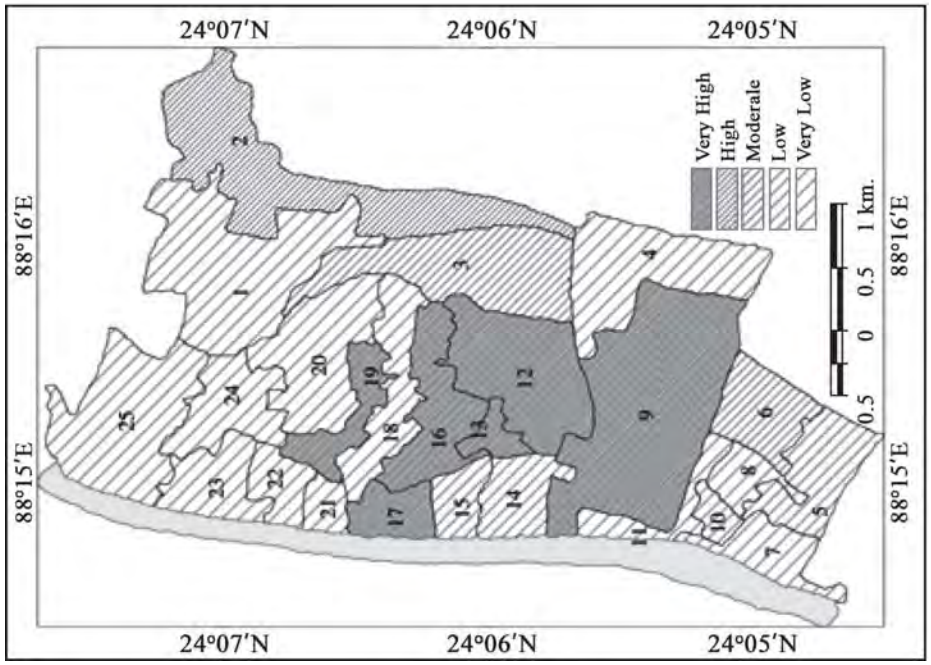

Fig. 4: Spatial Concentration of Economic Facilities

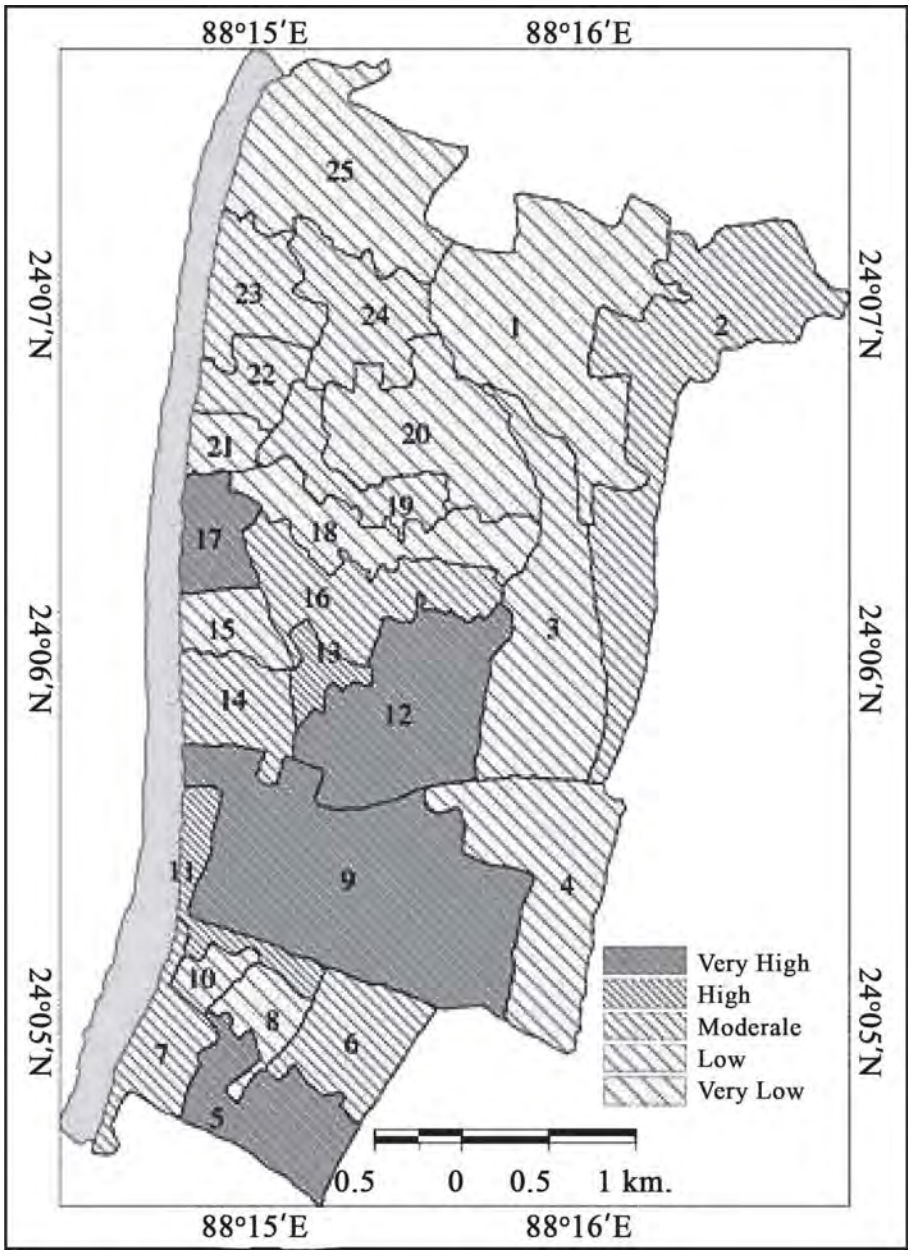

Fig. 6 : Spatial Concentration of Average Ward-wise Composite Score of Infrastructural Facilities in Berhampore Town

Source: Department of Urban Planning, Berhampore Municipality, 2017

within the town. In the study area, it is also identified that the economic facilities in the central part of the city are highly concentrated than the remaining portion of the town. Increasing the distance, decreasing the facilities in the study area is experienced. Many Harijan bastees or slums are also seen in the town. The wards dominated by slum people are deprived of the basic civic facilities in town. For up-gradation of many infrastructural facilities, some recommendations have to be implemented in the concerned town. The Government should establish a university for the enhancement of higher education among people of Berhampore town as well as in Murshidabad district. The number of primary health centers has to be increased in town. Many people of the Murshidabad district still depend on Berhampore town for various purposes like educational purpose. The Urban Local Bodies (ULB) should increase the facilities for education, health, economic activities and others in the town. Schemes related to infrastructural facilities have to be implemented to expand the level of various infrastructural facilities in the town.

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Social inclusion of Munda Tribe of a part of Sundarban Region in West Bengal

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Abstract : *Culture and society are always dynamic in nature thanks to exposure, invention, experimentation and change in the surrounding environment of the people. Tribal societies in India are also no exception. The Case study on the Munda Tribe is focussed in the context of social inclusion through three different dimensions: social, political, and economical. Traditionally tribal societies were self-sufficient: they did not feel it essential to interact with mainstream society for their social, cultural and physical existence. This very nature of tribal people kept themselves away from the rest of the society. The intervention policies particularly through education has provoked them to penetrate the mainstream culturally (example of inter-cultural marriages being on the rise) through assimilation process, economically through employment in government sectors and politically by active participation. The Sundarban Region is the study area with focus on blocks of Hingalganj and Sandeshkhali-I of North 24 Parganas district of West Bengal. Primary data was collected through Focus Group Discussion (FGD) and House Hold Survey (HHS) and Secondary data based on Census of 2001 and 2011: both qualitative and quantitative methods have been applied. This tribe has been purposely chosen as it is the dominant one population wise. Now Mundas are educated and better off economically; they are working in different Government and Non-Government sectors. They are actively participating in social organizations for furthering improvement in their society. They are commanding in political governance at local level through active participation. Social inclusion is increasing and at the same time exclusion is decreasing through such processes as revealed from the analysis of the data.*

Keywords : *Mundas, Social Inclusion, Intervention Policies*

Introduction

'Social inclusion' and 'social exclusion' are terms most widely used by politicians, social scientists and even the public. The term '**social inclusion'** originated in French social policy in the 1970s. It came into play in the 1980s' economic crisis (Benn 2000:310) when state sponsored republican tradition of solidarity was in vogue (Bhalla and Lapeyre 1997:414) and by the 1990's the term was theorized by scholars one among them being Luhmman who clarified the concept of inclusion being achieved individually (Luhmman 1990: 34) through access to the benefits and

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dependence of individual modes of living on them. The World Bank Group (2014) (https://www.worldbank.org) defined Social Inclusion as:

1. The process of improving the terms for individuals and groups to take part in society.
2. The process of improving the ability, opportunity and dignity of those disadvantaged on the basis of their identity to take part in society.

Different countries have different social structures, some more diverse than others. Cultural diversity in India is much more calling for a myriad of policy interventions. The Mundas of India live in the states of Bihar, Jharkhand, Chhattisgarh, Madhya Pradesh, Odisha, Assam and Tripura. They were originally inhabitants of North Western India who later moved to Chotanagpur plateau of Bihar and then to Sundarban Region and settled thereafter clearing the forests in West Bengal; they are also known as Manki, distributed in the districts of Medinipur, Purulia, West Dinajpur, Darjeeling, Jalpaiguri, and especially in North and South 24 Parganas of Sundarban Region.

Article 366 (25) of the Constitution of India refers to Scheduled Tribes (STs) as those communities, who are scheduled in accordance with Article 342 of the Constitution. The essential characteristics, first laid down by the Lokur Committee(1965), for a community to be identified as Scheduled Tribes are – (i) indications of primitive traits; (ii)distinctive culture; (iii)shyness of contact with the community at large; (iv) geographical isolation; and (v)backwardness. All these traits of Social exclusion were seen among the Mundas too. Different constitutional safeguards are: (i) the right to representation, in proportion to their population in the Union and the State Assemblies, ministries and local bodies; (ii)the right to representation, in proportion to their population, in the various public services under the centre and the state and all other local authorities;(iii) the special responsibility of the state to provide funds for higher education in the country and also abroad for members of these communities; and (iv) appointment of a special officer to keep a watch over the status of the safeguards enumerated above (Saksena, 1981). Mention must be made of Dr. B. R. Ambedkar who played an important role in the cause of the Scheduled Tribes in India towards social inclusion.

Conceptual Background

Social inclusion is the process of improving the terms on which individual and groups take part in a society – improving the ability, opportunity and dignity of those disadvantaged on the basis of their identity. The vision of inclusive growth, poverty reduction and bridging the gaps in society can only be achieved if there is significant improvement in the quality of governance. The *Intervention Approach* includes**:** electoral interventions, legal empowerment; budget; information; communication technology (i.e. technology interventions); natural resource management, interventions in the sphere of service delivery, etc. *Electoral interventions* include building new democratic spaces for citizen engagement, empowering local voices, civic culture, avoiding elite capture (i.e., manipulation by political elites), positive attitude towards government, social cohesion(transforming state-society relationship is a long term process).Through the 73rd &74th Constitutional

Amendment Acts establishment of elected institutions of local self-government, representatives of the weaker sections have taken place. The success however, depends on involvement of these representatives in planning, implementing and supervising the delivery of these essential public services. Development aims at creating a suitable and enabling environment for promoting long, healthy and creative lives. Governance, in any society, aims to ensure this through the exercise of economic, political and administrative authority (http://www.phileconsociety.org). Democracy, development and governance are interrelated goals.

'Ronald Labonte et al (2011) have worked on social inclusion/exclusion. They have taken various domains and their indicators regarding conceptual framework of social inclusion and exclusion. We adopted this concept and applied it in this research paper in the following way.

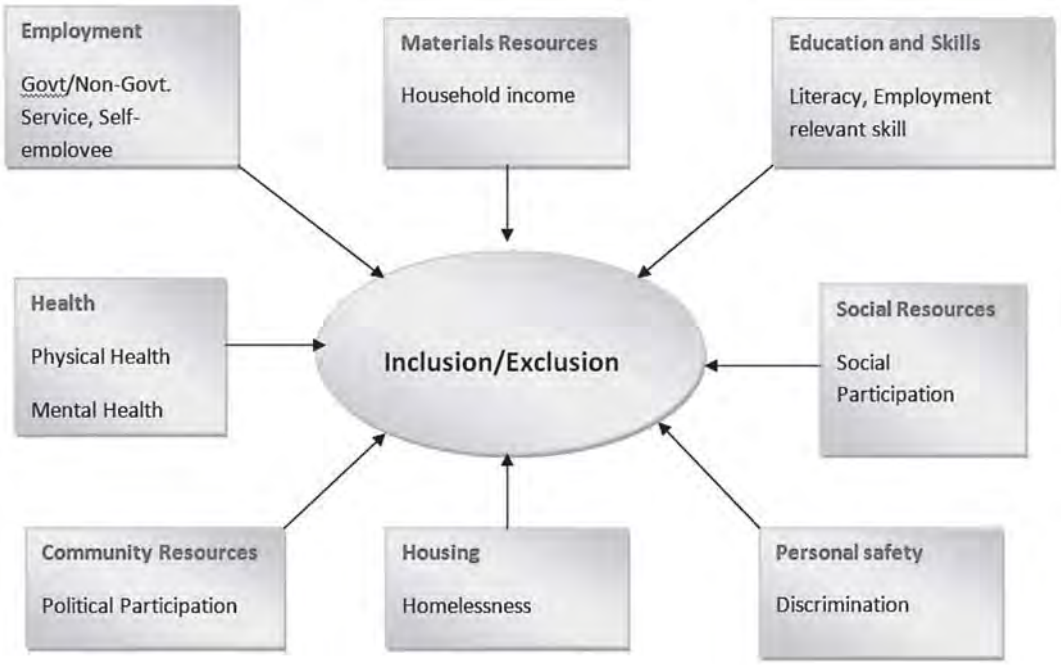

Fig. 1: Conceptual Framework of Social Inclusion/Exclusion

Source: *Labonte. R et al.2011.*

Research Question Formulation: As the tribal people in general and the Mundas in particular have been deprived socially, politically and economically in the past, the focus is on two definite problems:

1. To know about the inclusion status of the Mundas.
2. To study the implications with respect to inclusion

To look into these questions the techniques of multiple method of researching has been adopted:

Methodology

A systematic approach to synthesize evidence based on social inclusion indicators has been adopted. Our search strategy incorporated elements of qualitative systematic reviews. Such reviews utilize findings from studies that do not necessarily meet the normal inclusion criteria for quantitative studies. Hence quantitative methods have been also used based on domains and indicators of social inclusion after Atkinson et al (2002). MINITAB.14 Version software has been used to justify the nature of inclusion through Social, Political and Economic domains (after Labonte. et al. 2011). The Social Indicators are social resources, community resources, skill, housing and personal prestige /safety. The Economic Indicators are employment, income and independence of using it, while Political Indicators incorporated freedom of movement, economic stability, decision making power and participation in society's activities. Primary data was collected using the method of Focus Group Discussion (FGD) the group consisting of members belonging to different ages, different occupations and both male and female section of the target population. We have taken eight villages; each with fifty members in one focus group, so total target population was 400.The secondary data was collected from the Census (2001 and 2011).

The Study Area

To answer the research queries for fulfilling the objectives the study area was finalized and intensively field study was done on two community development blocks (Hingalganj and Sandeshkhali-I) of North 24 Parganas district of West Bengal comprising eight villages (Rupamari, Kothabari, Bishpur, Durgapu Bailani, and Dakshin Akhratala, Kalinagar, Bounia Abad, Boyarmari Abad). These villages have been purposely selected based on accessibility and demography characteristics. Both these blocks are reserved for Scheduled Tribes and/ Scheduled Castes in the Assembly constituency [always for ST in Sandeshkhali-I which has 25.94% (42,674) as tribal population] while Hingalganj ST/SC [as per population criteria has 7.30% (12,743) tribal population to total population in 2011]. Among the plain districts maximum concentration of tribes are found in both North 24 Parganas and South 24 Parganas according to 2011 Census. It is noticed that tribal people of Sundarban Region has developed quite fast and that rapid change in their cultural custom in terms of social inclusion is more than that which has happened in North Bengal and plateau region of West Bengal. In this regard the Sundarban Region has been chosen as the study area.

Result and Discussion

Social Inclusion of Munda Tribe

Social inclusion is the process by which people can enter the mainstream of our civic society while social exclusion describes a state in which individuals are unable to participate in social, economic, political, and cultural activities at a level considered to be normally acceptable. It is a broader concept than poverty, encompassing some characterizations of alienation and distance

Table: 1 Questions related to tribal inclusion: Domain and sub-domain

Domains	Sub-Domains or Indicators	Sub-Domain related Questions
Social	Literacy	Are you literate? How far have you read?
	Social Resources, Community Resources	Do you think you are a resource in your society?
		Are you participating in any community work?
	Skill	Are you computer trained?
	Housing	Do you a own house? Is your house constructed by own ? Finance or other financial support.
	Personal Prestige/Safety	Do you feel any problem regarding personal safety and security?
Economic	Employment	Are you a government employee? Are you self dependent?
	Income	Is the source regular in nature?
Political	Participation in politics.	Do you participate in local Gram Sabha meetings? Do you participate in local and assembly political meeting? Do you participate in legislative politics? Do you participate in Parliamentary politics?

from mainstream society. To gauge into the state of this social inclusion/exclusion of the Mundas study on the different schemes and strategies adopted and implemented was done which included the Tribal Sub Plan (TSP) Strategy implemented since 1974-75. It is a multi-pronged strategy which includes support for education, health, sanitation, water supply, livelihood etc., and the state of West Bengal is covered under it.

The tribal groups are at different stages of social, economic and educational development and to gauge the development of the Mundas we have taken specific *social indicators* of social resource, community resource and skill. On the basis of the FGD only a very few aged (> 59years) people have entered the mainstream of the society; within the young age groups of 15 to 59years it is more and it is growing. This young age group is now raising voice in favour of social inclusion. Skill is the main pillar to promote or provoke in individuals as social resources or community resources as

a whole, because when individuals are coalesced with each other they turn into a big social as well as community resource. Literacy rate leads to develop the skill of people and skill is one of the indicators of social inclusion domain. Literacy rate of the Mundas is quite high in both blocks. According to 2001 and 2011 Census literacy rate of blocks of Sandeshkhali-I and Hingalganj are 61.67% and 64.70% respectively, the corresponding all India and West Bengal figures being respectively47.10% and 43.40% for 2001 and 58.95% and 57.93% in 2011 . Male and female literacy rate of Sandeshkhali-I are 70.53% and 52.57% respectively while that of Hingalganj are 74.99% and 54.28% respectively. Hence literacy is now increasing. Therefore, with the educational skill and knowledge gained the Mundas are uplifting.

Regarding social security, Government of India has launched several Social Security Schemes such as Pradhan Mantri Suraksha Bima Yojana (PMSBY), Pradhan Mantri Jivan Jyoti Bima Yojana (PMJJBY), Pradhan Mantri Kaushal Vikash Yojana, Pradhan Mantri Jana Dhan Yojana and Atal Pension Yojana (APY), etc.

The Department of Housing, Government of West Bengal launched Akanksha, Gitanjali, Amar Griha besides the Central Government's venture of schemes implemented on the basis of monthly income of the family in rupees : (i) Economically weaker section (EWS) income up to 10, 000, (ii)Low income group (LIG) income between 10,001 to 15, 000, (iii)Middle income group lower (MIG-L) in between 15001 to 25000, Middle income group upper (MIG-U) in between 25000 to 40000 and (iv)High income group (HIG) with income of 40000 and above. As per field survey and FGD, housing pattern has changed. One third (30%) of houses are pacca and rest are normal i.e. (mud) kuccha. Of the 30% of pacca houses, two thirds are constructed based on funds from Pradhan Mantri Awas Yojana (PMAY) and rest with their own financial support.

Housing pattern is one of the indicators of social inclusion. The Gram Panchayet data reflects that housing pattern is transforming to pucca one gradually; hence the physical quality of life is also being raised. In all the studied villages falling within the two blocks only about 5% households have got the opportunity. Rupamari village of Hingalganj block has got more benefit from both central and state housing scheme (10% households) due to priority of Panchyat Pradhan compared to the other villages. Similar is the case of Bayarmari Abad village of Sandeshkhali-I block (10% to 12% households) according to Gram Panchayat's information. Through the Block and Gram Panchayat information, housing related beneficiaries from both government schemes increased from 3% in 2015-16 to 20 -25% households in 2018-19. Hence the Mundas here are entering gradually into the normal societies in terms of housing: however the share of benefit is low which testifies that still social exclusion prevails. Regarding personal prestige with regard to the practice of untouchability or using abusive words, the mainstream society is now cordial there was no discrimination felt said the respondents. This is as per their psychological feeling related to their personal safety while interacting in the public arena. This indicates socially included attitude towards them.

Data analysis

The secondary data regarding social inclusion indicators are all strongly committed to inclusion. So also is the primary data collected through household survey. The correlation matrix has been chosen to prove that the tribal people are penetrating into the main stream society. If p-value is >.05 then people are included hence null hypothesis is true as seen in the table (Table-2)

Table: 2 Correlation matrix table for data analysis

Main Domains	Indicators	p-value
Social inclusion	Education	0.227
	Skill	0.405
	Community resource	0.581
	Housing	0.405
	Personal safety	0.581

Source: Data compiled from house hold survey.

Earlier tribal people depended on traditional treatment towards their health. But nowadays they have changed their medical treatment procedure due to change in medical technology and spread of awareness. About 90% of the sample of our tribal people preferred allopathic treatment, 8% Homeopathic and only 2% are still depending on tradition medicine.

Economic Inclusion of Munda Tribe

Economic Inclusion is the process by which people can participate in the common economic sector. India has recently instituted laws and schemes to support the ability of the most vulnerable to access their rights (Mehta et al 2011). These include the 2005 National Rural Employment Guarantee Act (now known as the Mahatma Gandhi National Rural Employment Guarantee Act-MGNREGA), which obliges the state to guarantee hundred days paid employment each year to chronically poor rural households while providing sustainable infrastructure to rural areas. Some of the most important programmes relevant to employment and food security are the Targeted Public Distribution System (TPDS), the Integrated Child Development Service (ICDS) Programme, the Antyodaya Anna Yojana (AAY) and the Annapurna Scheme; Mid-day meal (MDM) programme and the National Old Age Pension Scheme (NOAPS).The provision of food subsidy is through Antyodaya Anna Yojana (AAY). The launching of National Rural Livelihood Mission (NRLM) in 2011 needs also to be mentioned as it has an impact.

Another Financial Inclusion Programme is Stand-Up India Scheme(15th August, 2015) by which people can get Bank loan between Rs 10 lakhs to Rs 1 Crore and at least one ST person can get loan from one branch in their locality. In case of Non-Individual enterprises at least 51% of shareholding and controlling stake should be held by either an SC/ST or women entrepreneur. Pradhan Mantri Jan Dhan Yojana(2014), Pradhan Mantri Mudra Yojana (2015) etc are the important

Economic inclusion schemes in our country. Pradhan Mantri Fasal Bima Yojana (2016) has been introduced for development of agriculture production. In this scheme, Government of India is supporting sustainable production in agricultural sector by providing financial support to farmers suffering from crop loss/damages arising out of unforeseen events and stabilizing the income of farmers to ensure their continuance in farming. About 20-25% tribal households achieved this opportunity.

The Department of Information and Cultural Affairs of West Bengal (2015) have launched a scheme (Folk Artist) for tribal people. They have made a group and each Folk artist group should have a minimum of 11 and maximum of 15 members. The male and female ratio of these groups is 2:3. In these groups, each member should be a tribe. They are performing their dance in various governmental programme and other programmes. They are getting remuneration per month of Rs 3500 per member for their performance. In this regard, women work participation rate is greater than men. These dance groups also promote the tourism in Sundarban Region. They are also now earning the money from the public tourism sector. It is a good example of economic inclusion of Munda tribe of Sundarban Region.

About 5% people are engaged in Government service and 15% people are engaged in Non-Governmental Service. Rest 20% people are self-employees (self help group and shop owners) and 60% people directly or indirectly are working in agricultural field. Therefore, it is clear that economic inclusion is growing in different sectors. Government service is increasing slowly among Munda tribes but NGOs and Self-Employment is increasing at a faster rate compared to Government Sectors.

Primary data from HHS has proved that tribal people are being included through governmental interventions. With help of the binary logistic model established the financial inclusion of tribal people is shown in Table 3 where all three indicators are positively associated with economic inclusion.

Table: 3 Binary logistic regression models for economic inclusion

Economic inclusion	*Odds ratio	(95% *CI)	*P
Indicators			
Government Employee	2.310	1.04-5.15	.041
Self-dependent	4.670	2.36-9.25	.011
Income	8.979	2.31-8.25	.012

Source: Compiled based on sample data

{*OR: odds ratio, *CI: Confidence interval}, *P- Hypothesis null or alternative.

Political Inclusion of Munda Tribe

Political participation includes a broad range of activities through which people develop and express their opinions on the world and how it is governed, and tries to take a part in and shape the

decisions that affect their lives. These activities range from developing thinking on various social issues at the individual or family level, and campaigning at the local, regional or national level, to the process of formal politics, such as voting, joining political party, or contesting in elections.

Political inclusion is the capability of all citizens to participate in making collective decisions about any matter that effect their life. Political right includes right to speak, assemble, vote, hold office. More basic right to the rule of law (to be safe from state violence and crime, to move about or to occupy public space) are broadly inclusive. Politically inclusive development should improve governance; bad governance certainly impedes development (Kurtz and Shrank 2007). It has been seen that women turnout during India's parliamentary general elections was 65.63% compared to 67.09% turnout for men. India's rank is 20th from the bottom in terms of representation of women in Parliament. As per the Government of India reservation rule 8.1% of tribes have entered India's Politics. Both Male and female candidate are fully absorbed. In Hingalgunj block, 12 male and 16 female candidates were elected also in Sandeshkhali Block, 12 male and 16 female candidates were also elected through Panchyat election in 2017.Sukumar Mahato was elected as a member of legislative assembly (MLA) in Sandeshkhali-I block in 2016.

Therefore, if tribal people are socially and economically strong; there is no doubt concerning their political involvement. We explored how tribes directly or indirectly are involved into the political empowerment by taking variables of i) Freedom of free movement ii) Economic security and stability iii) Support by family/freedom from domination iv) Decision making in daily life and v) Participation in society activities.

Logistic regression analysis through Binary Logistic Regression Model

Table 3: Dimension of empowerment associated with political inclusion

Political involvement of tribal people			
Independent variables	OR*	(95 % *CI)	P
Dimension of tribal empowerment			
Freedom of free movement	4.18	(1.42-12.31)	0.009
Economic security and stability	8.98	(1.52 53.20)	0.016
Support by family/freedom from	0.59	(0.12 3.03)	0.529
domination	15.45	(4.54 52.55)	0.001
Decision making in daily life	7.73	(1.52 39.38)	0.014
Participation in society's activities	7.73	(1.52 39.38)	0.014

Source: Compiled based on sample data

{*OR: odds ratio, *CI: Confidence interval}

Table 3 show the binary logistic regression analysis on empowerment associated with political involvement (independent variable) with four control variables. The two factors that were significantly associated with the political participation are (i) Decision making power in daily life and (ii) economic stability .Both are highly associated with the political participation and directly correlated with the objective. The former is more than the latter. Participation in society's activities is also positive and significantly associated with the political command. Women who are not able to get support from the family and do not have freedom of movement are less associated with political participation. Sixty Five women participants (16.25%) answered that they are politically attached at the local level. One is the Upa Pradhan (Susmita Sardar) in Bailani Gram Panchayat and her husband is secretary of Local committee in ruling party (TMC). Sanatan Sardar is the Panchayet Pradhan of Rupamari Gram Panchayet of the same party. Although this percentage is very low but it is symbol of political women empowerment or political inclusion and at the same time they are participating in community activities (39.68%) and are aware of community activities (44.97%). Awareness of community activities such as "Birsa Munda Birth Day", celebration of "Hull Dwibas" etc.; are the efforts to keep alive their identity in the main stream society.

Conclusion

We know that society is not static; it is always changeable. The tribal culture and their society is no exception. Changes of tribal culture will happen through social inclusion process. Discussion of social inclusion relates citizenship debates, particularly in terms of dichotomy between individualism and collectivism. Walker and Walker (1997: 8) mentioned of the dynamic process of being shut out from any of the social, economic, political and cultural systems which determine the social integration of a person in society. We have studied three basic dimension (Social, Economic and Political) and also related indicators about tribal people. There are more changes: the extent and intensity of such changes primarily depends on a society's need-based integrity to its cultural components and way of life. Accepting new culture and changing surrounding environment; tribal people are changing their society. With the positive discrimination at present, they are experiencing detribalization and identity crisis. However this issue has not been dealt with in this paper.

The Indian village community is changing rapidly with the advent of participatory politics. Participation has been identified as the most important element in development programmes. Participation may extend to the involvement of beneficiaries in information sharing, consultation, decision making, initiating action in the programme activities, etc. It fosters individual and community empowerment, overall economic and environmental benefits, greater target population outreach, improvement in access to resources, improvement in management and organizational skills, strengthening local organizations. Equity & inclusiveness is crucial for the most vulnerable and marginalized sections of the society to have the opportunities of well-being along with the mainstream society (Basu, 2014). This is particularly so in the service delivery with a positive impact on uptake and use of services in the various sectors (e.g; in education the involvement in the management of this service has resulted in a greater enrolment rate.)

Recommendations

It is the bureaucracy which should work effectively as the link between the people and their representatives. Creation of an orientation of the right type for bureaucracy is vital for the success of any decentralization process. In Panchayati Raj Institution this is crucial (D. Sundar Ram 2007(Ed) as it is the bureaucracy which translates the aspirations of the people into reality (www.developmentfirst.org). Several reports such as the Annual Report of 2014-15 by the Tribal Welfare & Development now indicate weakening of institutions specifically meant for delivery of goods and services to tribal population i.e. Integrated Tribal Development Agency (ITDA)/Integrated Tribal Development Projects/Tribal Research Institutes (TRI) and other Micro Projects. The political intrusion of non-tribal into the tribal authorities made the tribal people vulnerable to socio-economic exploitation. Thus, they adopted the strategy of entering the mainstream society for their survival and for a better quality of life by accepting jobs, education and non-traditional way of life. The study on domain showcasing that the Mundas have adopted a mainstream way of life is a good sign. However blending of the traditional and the modern, needs to be local specific and context specific.

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Landscape, Culture and Cinema: A Study in Film Geography

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Abstract : *Cinema and landscape are cultural entities and thus both are produced as a result of dynamic interaction of human, nature and environment .It comprises of both tangible and intangible features. The beauty of cinematic landscape is that it captures space and time in motion which is artistically created and contains aesthetics inherently. The spatial and temporal attributes attached to cinematic landscape representation; act as a stimulus for geographic enquiry, which has not found place in mainstream professional geography, particularly in countries like India. Cinematic landscape representation and interpretation is mediated by one's attitude, perception and culture. This article is an attempt at critical examination of cinematic landscape representation and the role played by landscape in identity formation. It also throws light on significance of film as a source of cultural geography in brief, with the view to promote future studies in this field.*

Keywords : *Cinematic landscape, Film, Culture, Identity, Bollywood, Hollywood, Cultural Geography, Space*

Introduction

Landscape is a unique synthesis of physical and cultural characteristics of a region. The term ''cultural landscape'' has been a fundamental concept in human geography.The origin of the word 'landscape' comes from the Germanic languages. One of the oldest references in the Dutch language dates back to the early thirteenth century when 'lantscap' ('lantscep',landschap') referred to a land, region or environment. It is related to the word 'land', meaning abordered territory, but its suffix -seep refers to land reclamation and creation, as is also found in the German 'Landschaft' — 'schaffen — to make. J. Wimmer was perhaps the first scholar to use *landschaftskunde* in his work *HistorischeLandschaftskunde* (1885).The concept ''landscape modified by human activity'' as an academic term was introduced by German geographer Friedrich Ratzel in 1890. It is known as *paysage* in French; *paeesaggio* in Italian; and, *bhoodrishya* in Hindi. Its popular acceptance as an academic term in geography could be seen after Otto Schlüter's famous 1906 address at Munich. The term became familiar in English speaking world by the American geographer Carl O. Sauer (1925) who in his seminal work stated, "...the cultural landscape is fashioned from a natural landscape

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by a cultural group. Culture is the agent, nature is the medium, and the cultural landscape is the result" (p.315). Landscape expresses the visual illustrations of the territorial identity. The earliest realistic portrayal of landscape date from the fifteenth century, in particular in Renaissance painting which emphasized visual character and symbolic meanings. Landscape also became an expression of human ideas, thoughts, beliefs and feelings. The International Geographical Union (1938) made it clear that a geographical landscape is not simply a physiological or an aesthetic entity as analyses have shown that it embraces the whole range of generic and associated functional relationship between units on the earth surface enabling characteristic group or sub-group to be identified.

The spatial and temporal attributes attached to cinematic landscape representation act as a stimulus for geographical enquiry. Cinematic landscape captures the space and time in motion which is artistically created. Cinema has a mechanical ability to represent the world through moving images which shapes our perception of ourselves, as well as the world. Cinema generally takes us to the world of imagination or fantasy; at the same time, it shows the truth or reality of the world. Cinematic landscape representation and interpretation is mediated by one's attitude, perception and culture.

This article's primary concern is to critically examine landscape representation in cinema with a brief focus on significance of film as a source of cultural geography. Accordingly, it is organised into following four major sections: cinema and geography; place of landscape in regional/place identity and culture; landscape as represented in cinema; and, significance of films as a source of cultural geography before attempting a few preliminary conclusions.

Cinema and geography: the interface

Lukinbeal and Sharp (2014) suggested in *Geography and film* that "Geographers by and large took interest in film as a subject matter during late 1980s. One of the first insights into film and other popular media forms by geographers was *Geography, the Media and Popular Culture* edited by Burgess and Gold (1985). In this work, the editors outlined two tracts of media research: the so-called American school, which accentuates individual cognitive response to media; and, the European school, which highlights social theory and stresses on the role of media in society. In attempts to ease this division and also to provide a framework within which the new subfield could develop, Kennedy and Lukinbeal (1997) argued that rather than seeing film geography as composed of two unrelated areas of inquiry, the two tracts outlined by Jacqueline Burgess and John Gold (1985) should be thought of as two extremes on either side of a continuum, with discrepancies but also overlap(p.3).

With the publication of *Place, power, situation and spectacle:A geography of film*, edited byAtkin and Zonn(1994), a new era was heralded. It addressed the assumption that film should and could provide a transparent window on the real world as Geography in general engaged with broader scale academic debate over the 'crisis of representation'. So those interested in film began to address "the relationship between the real and reel" (as cited in Aitken& Dixon, 2006, p.327). Fourteen geographers examined the effect of cinematic representation of place and space on

perception of self and societies in the world in this book by using contemporary film theory and elements of socio cultural and political discourse.

Engaging Film: Geography of Mobility and Identity, edited by Tim Creswell and Deborah Dixon (2002), is a creative interdisciplinary volume that explores the engagement among films, space and identity and features a section on the use of film in classroom as a critical pedagogical tool. A significant challenge to the hegemony of the textual metaphor is attempted through the paradigm of mobility, which is put forth as "an element in the play of power and meaning within social and cultural networks of signification" (p. 4). In an article titled 'Imagining Geographies of Film', Aitken and Dixon (2006) provided a summary and critique of the film geography literature and suggested that future research should take a more critical approach to the intersection between "lived experience" and "the images and material conditions" that continuously produce and reproduce our daily lives (p. 335). Lukinbeal and Zimmermann (2006) have tried to present a brief history of film geography, highlighting the German tradition, and suggested that there are four key areas of current and future research into film by geographers. They make an earnest argument against representational views of cinema. On the basis of modality, taken by contributing authors as the primary means of investigation, the editors have organised the ten essays of the volume around the author, text and the reader. The editors duo have also discussed the benefits and limitations of the author-text-reader model used by film geographers

Aitkin and Dixon (2006) suggested that to an extent geographic study of film has come of age and it is important to not only tie it to disciplinary source but also to put theoretical boundaries. Geographical concern ~~is~~ often lacks a critical perspective focusing primarily on the geographic realism of film rather than how they produce meanings. Geography needs to elaborate insights through critical spatial theory so that (our) studies are not about filmic representation of space but are also about the material condition of lived experiences and everyday social practice" (cf. p.326). Critical insights are needed to put theoretical boundaries across this new sub-discipline of film geography. A relationship should and could be established between the reel and the real with a primary focus on geographic realism of film.

Place of landscape in regional /place identity and culture

In a recent work, Roca, Claval and Agnew (2016, p. 1) have made a very important observation that, "Landscapes are treasures of the past, frame contemporary everyday life, and affect future environmental, economic and cultural processes. As material custodians of both historical memory and the sense of place, landscapes encapsulate our attachments, emotions, perceptions and knowledge, as well as our interests, decisions and actions. Modern societies are marked by identity crises which, all too often, involve major landscape disruptions. In this context, landscapes are no longer just the 'scenery' of either local or globalized economies or cultures. They increasingly gain economic and cultural value in their own right". Such an observation makes it apparent that landscape is a wider concept which includes both tangible and intangible features. It reflects the human progress with in respect to time. In the present era of globalisation, distinctive characteristics of landscapes have lost their importance which result into identity crisis. When we talk of cinematic

landscapes in a global world, the issue of identity crisis becomes more prominent where Toronto is the other New York and Alps is the other Kashmir (Lukeainbeal,2005).

Place identity

"People and landscape both are in constant interaction", or as Turner (2006, p. 387) puts it, today landscape is a form of active material culture that has shaped people and has been shaped by the landscape (cited in StobblerandPedroli,2011, p.5). He further adds that "people can have a sense of belonging to a specific landscape, often in the region where they spent their youth or where they experienced a crucial period in their biography. The identity that people derive from the landscape in that region is called' place identity' (cf. Jorgensen & Stedman, 2001; Olwig, 2006; Proshansky et al., 1983) or 'existential identity' (Boerwinkel, 1994; Gualtieri, 1983; Van Mansvelt& Pedroli,2003; Van Zoest, 1994). Thus, when discussing existential identity, not only the objects in and the features of the physical environment are issues but also the associations, memories and symbolic meanings attached to the physical landscape(the social and cultural environment), observes Schama (1995). In this context, existential identity is considered as an inherent quality of the landscape as perceived by people. The study of landscape from this perspective is a relatively new development (Olwig, 2002; Setten, 2004 as cited in StobblerandPedroli, 2011, p.5).The filmic representation of places, landmarks of architecture develop or make a sense of place. The people derive their identity from such on-screen places and can connect themselves with such places according to their attitude, culture, association and memories (Koeck, 2012).

Spatial identity

Stobbelaarand Pedroli (2011) also talked about the spatial identity and suggested "a much longer tradition has the second implication of the concept of identity, whereby people ascribe identity to their environment, or in other words: they characterise the landscape". This is termed as 'spatial identity' (Van Zoest, 1994), 'landscape character' (Antrop, 1998; Wascher, 2005) or just 'landscape identity' (Antrop, 2000, 2007; Palmer and Roos-Klein Lankhorst, 1998). "Spatial' in this sense has a broad meaning; far broader than, for example, the visual aspects of landscape, it includes orientation, distances, ordination, etc. Spatial identity of landscapes is based on forms, patterns and elements (but also colours and processes, and even sounds and smells—those features by means of which people recognise landscapes" ((cf. Stobbelaar& Hendriks, 2006, p.6) The spatial organisation of the cinematic landscape is simply the spaces where the narrative of the story is unfolded. Filmmaker ascribes meaning to such spaces according to the narrative of the film. Cinematic landscapes are the space of actions where different shots of the camera from different angles are taken in order to limit viewers up to dialogue between the actors.

Cultural identity

The basis of cultural identity are values, signs, symbols, associations which is attached to a particular landscape. Cultural identity includes the ways people interact with cultural landscapes. This interaction is achieved due to awareness of natural and cultural values. As suggested by Nezam, et al., "Moreover, the values create a distinct identity which is the result of communication

between people and landscapes (cf. Stephension,2008).Cultural identity is the basis of cultural heritage and values of cultural landscapes are the basis of cultural identity. The local and native people, who are the constructor and keepers of cultural landscape, consider location values as the inseparable part of their cultural identity. Indigenous people live in the landscape and consider the identity, history and nature as the values of cultural landscape which they have maintained since their past to present. Cinema reflects the vision as well as reality of the society. The onscreen portrayal of value-based society forms the basis of cultural identity. For instance, the motherly figure in Hindi cinema is portrayed as moral keeper, wherein the moral duty is heavily lean on motherly figure.

Landscape as represented in cinema: the over-linked aspect

Lukinbeal(2005) while explaining cinematic landscape said, "a region's cinematic landscape can never be realised but always leads to new taste, new context, and new configuration of meaningful exchange within an ongoing system of production" (p. 172). The geographic meaning is made with the cinematic landscape representation. Harper and Raynor (2010, p. 16) mention that 'like a map the cinematic landscapes is the imposition of order on the elements of landscape collapsing the distinction between the found and the destructed'. The orderly pattern of landscape exhibited by cinema fascinated the geographic enquiry in a detailed way. Landscape representation in cinema always used as a space, metaphors and spectacles. Metaphors in cinematic landscape can be perceived to be similar to landscape as spectacles. Landscape metaphor breachs into the hidden meaning of landscape. Various physiographic features of earth is used for expressing human emotion such as green vegetation, snowy mountains and hills for romance, rain for sadness, love and sometimes to depict joyous atmosphere, rugged topography of desert to depict loneliness, breakups etc. Here the brief sketch of landscape representation in Hollywood, Bollywood and regional cinema of India are presented (Lukeanbeal, 2006).

Hollywood

Powdermaker (1950), as cited in Ibbi (2013, p.96), described Hollywood"... a unique American phenomenon with a symbolism not limited to this country. It means many things to many people". Hollywood may be defined as a "global industry which is geographically concentrated in southern California with a truly global reach. Bi (2012) stated that "culture, in particular the movies produced by Hollywood, is one of the cornerstones of this endeavour. Another word for the American dream, Hollywood serves to extol the virtues of the American way of life, promotes major industrial products and builds and reinforces a positive national image." He further adds that Bi (2012) has also stated that "Hollywood movies seek to build a national image characterized by freedom, equality, prosperity and other positive aspects. Concepts such as "freedom" and "equality" are reinforced through storylines." (as cited in Ibbi, 2013, p.96). Hollywood movies are key cultural artifacts that offer a window into American cultural and social history. The way these movies have influenced the culture of people around the world is a major source of concern as expressed by Burrowes (2011), "the success of American film has led to other nations fearing that their own cultural identity would be tainted, altered somehow by this Hollywood influence". Portrayal of Hollywood's domination of

the global film industry was best painted by the movie director, Steven Spielberg in Branston (2000), "it is not domination by American cinema. It is just the magic of storytelling and it unites the world." The unity brought about by this magic of storytelling has been termed by many as 'cultural imperialism'. One of the main problem faced by Hollywood is the issue of minority representation particularly black, women and the community of LGBT group. *Moonlight*(2016) of Berry Jenkins is one of the Oscar (one of the highest international prize) winning film. In the field of cinema, with a central theme of representing the three stages of life of an African-American gay named Chiron struggles to find his identity in a contextual society. He is truly representing a gay who is poor and black who is born without inherent worth.

Bollywood

In a country like India, culture plays a dominant role in society than visual representation of landscape, became central to public discourse. Bollywood industry is not just the imitation of the Hollywood. It has its own international brand of music, dance and drama. It reflects the changes in Indian polity, economy and society. Post-liberalisation has caused ~~the~~ widespread change in landscape representation in Bollywood. In 1993 when the National Democratic Alliance (NDA) government granted Bollywood cinema the status of industry, the nature of film financing got quickly changed and the corporate sector stepped into movie making. This meant the use of big

Fig. 1: A typical rural landscape of a remote village of north-eastern Bihar as portrayed in *TeesriKasam*(1966).

(Source: http://www.rangooski.com/video/5142/maare-gaye-gulfam-teesri-kasam-1966-raj-kapoor)

stars, extravagant romance, affluent lifestyle and film shootings in fancy locations. Such film shootings transformed the conventional landscape representation and consequently their interpretation. The first indigenous silent feature film 'Raja Harishchandra' was directed and produced by Dhundiraj Phalke, known as "the father of Indian cinema", in 1913. Narrative of the story was based on the internationally famous Sanskrit epic Ramayan and Mahabharat. This first indigenous film was simple though with immense potential for visual extravagance. The perception, experience and content of cinema changed with the advent of sound and the first torque of Indian cinema was 'AlamAra' (1931). Another significant change in Bollywood cinema is its interaction with the literary sources. 'Teesri Qasam' (1966),a movie which eases the understanding of a novel written by Phanishwar Nath Renu which depicts the plight of rural Bihar. The acting of Raj Kapoor and Wahida Rahman may be seen at its zenith. Theatre, text, image, industry, event and narrative all come together to form cinematic landscape (Shah, 2017).

Several movies shot before 1990 were on indigenous soil most of which depict indigenous daily rural life—society, culture and economy. For instance,'NadiyaKePaar'(1982) directed by Govind Munish and set in Ballia district of Uttar Pradesh (UP). It was adopted from the first half of a novel titled *Kohbarki Shart* (in Hindi) authored by Keshav Prasad Mishra. The movie plots the rural

Fig. 2: One of the most remembered scenesfrom the frame of'Nadiya kePaar'(1982) shot in Ballia district, UP.

(Source: http//images.app.goo.gl/kKch8bSENjNgSv3W6)

landscape and rural culture of Eastern UP. The symbolic role of *Bhauji*('sister-in-law') reflects the importance of women as home-makers. The initial struggle of Chandan and his family before his brother's marriage indicates how a woman handles household chores so easily,which a man cannot. Landscape such as public wells, streams, mudand brick made houses with inner courtyard, hearths, roads,fascinating greenery etc.are the reflection of a rural environment which is too simple and its people free from all odds and disturbances. These images based on rural presentation seek audience connection who identify themselves with such socio-cultural fabric and these landscape elements.

Since 1990s widespread changes across Indian cinema may be found attracted towards foreign location, a promptand frequent tendency seen on film shooting in Bollywood. Up to the 1970s, foreign locations were used for only song sequences. But a discernible shift in place making of cinematic space in Hindi films occurred in 1995 when 'Dilwale Dulhania Le Jayenge'(DDLJ),*1995*used foreign locations as perfect setting of romance. London was used as physical settings such as Trafalgar Square, Big Ben Tower, Buckhingum Palace, King Cross railway station and the snowy Alps andpastoral fields of Europe etc. which were quite appealing and developed a sense of place to its audience(cf. Mishra,2018).

Fig. 3: South Hall, London, a popular locations for the shooting of several Bollywood movies including'Dilwale Dulhania Le Jayenge'(1995) and 'Hum Dil de ChukeSanam'(1999)

(Source: https://timesofindia.indiatimes.com/travel/destinations/8-beautiful-locations-thatll-refresh-your-memory-of-dilwale-dulhania-le-jayenge-/amp_articleshow/45296548.cms)

Regional CinemaofIndia

India is home to one of the largest film industry in the world. Indian film industry comprises of Hindi,and regional movies including art and popular commercial cinema. Some of the popular regional film industries in India are Bengali, Tamil, Telugu, Kannada, Malayalam and Punjabi. Among these Bengali cinema has an older legacy than Bollywood. Tollywood is metonym for the Bengali film industry, centered in Tollygunge in Kolkata. The Bengali film industry is notable for having rare talented directors like Satyajit Ray, an internationally renowned filmmaker and a winner of many awards. Mukherjee and Bakshi(2017) suggested, "...the idea of 'Bengali' cinema, we would like to argue, became forceful with the advent of sound in India; simultaneously, subjects of language and nation became significant within the debates on cinema and its making" (p.116).The best-known event of the 1950s Bengali cinema is nonetheless Satyajit Ray's 'PatherPanchali' which was released in 1955 and won "Best Human Document" at the Cannes Film Festival (1956). It was appreciated by filmgoers and critics alike, as was 'ApurSansar', the third film of Ray's Apu trilogy, which had a silver jubilee in Calcutta (now Kolkata).It was indeed one of the greatest works of Ray, with scenic beauty which leaves in our mind, traces worth remembering. Poverty makes life hard, but to Apu and Durga, as innocent they are, their child-like little activities bring us back to childhood nostalgia. These regional cinemas present a better picture of contemporary social issues and depict the social life in a much more comprehensive manner. Bengali cinema has its own classics. Many believe that no other regional cinema can compete with the Bengali cinema. However, the existence of well-acclaimed films has been produced in majority of regional languages. Among them, Bhojpuri andTamil cinema have their regional importance which seeks greater connection to respective audience but only at the regional level not a wider level as Bengali cinemahave had the privilege. Bhojpuri cinema is always charged with the metaphors of decay,break-down,lawlessness,like problems of Bihar and eastern UP.

Fig.4: Landscape of rural Bengal as portrayedin PatherPanchali(1955)

(Source: https://m.imdb.com/title/tt0048473/mediaviewer/rm3254187776)

Significance of films as a source of cultural geography

Since very ancient times, niche-specific study hasbeen the concern of human geographers in order to understand human-environment relationship. Cultural geography, as a sub-fieldwithin human geography, is mainly interested in cultural landscapes. The study of cultural landscape was led by the Berkeley School of geographical thought under the able leadership of Sauer. Cultural landscape, as defined by the world heritage committee, " ... is the cultural properties that represent the combined work of nature and human". When culture interacts with the natural landscape, a cultural landscape comes into existence. According to Ming (1979), "any landscape is composed of not only what lies before our eyes but what lies our head"(cited in Mishra,2018, p.34).Every individual constructs the meaning of visual landscape according to theirown perceptive abilities. This landscape, seen in the backdrop of cinema, which provides meanings to the narrative for events, is a subject matter of cultural geography. Film in itself is a cultural entity which is created by human art after interacting with the nature. This artistic feature of human beingshas presentlyinfluenced every corner of the world. Crossgrove who noted "landscape as a cultural image a pictorialway of representing structuring or symbolising surroundings that privilege the sense of sight and often emerge as a vital field of expression and contestation"(as cited in Mishra,2018, p. 61,63). The cinematic representation embodies in itself ideologies**,** emotions, explanation, interpretationand so on. Thus, cinematic landscapes are a rich resource for landscape analysis and interpretation .Landscape is not just the commodity, it s a source for identity, an element of mediation, a part of individual or collective fantasy and imagination not just a part of cultural fabric for an ideology and spectacle but far too profound and prolific in both physical and virtual space of creativity.Visual representation of landscape in cinema provide an opportunity for a wider social discussion and act as a synergy between human and geography.

Landscape is the reflection of cultural maturity of a region. It represents and symbolises surroundings. Though the cinema has its own events and narratives; but, without a specific landscape at the backdrop, all cinematic events go in vain as any cinematic narrative is meaningless without proper landscape representation in the backdrop. Bollywood movies that are staged abroad or present the Indian society and culture in foreign locations infuse the sense of pride for the nation (India) among the viewers. 'Dilwale Dulhania Le Jayenge' (1995),'KalHo Na Ho'(2003), 'Namaste London'(2007) are some of the movies that create a sense of cultural identity abroad. These movies represent how middle-class immigrants from India are deeply rooted in the Indian ethos and spread the fragrance of indigenous culture abroad. Lukinbeal and Zimmerman(2006) rightly suggest, "With the rise ofhumanistic geography, and other counter movements to the quantitative revolution, interest in literature, art, media and films began but never truly developed".Following the "cultural turn" in geography and debate over 'traditional' and 'new' cultural geography, non-material cultural forms of inquiry rose to prominence.However, an invidious distinction between what constitutes geographic research has kept this subfield from truly growing and thriving. The rise of critical cultural geography and disciplinary interest in such key issues as the 'crisis of representation, film geography should be moved from the peripheries to become a

central issue in geographic research and pedagogy" (p.321). A theoretical and analytical approach is needed to make this sub-discipline flourish. The question of crisis of representation should be kept in mind in order to give geographical bent to studies in this sub-disciplinary area.

Preliminary Conclusion

Throughout the discussions presented in previous sections, we have tried to argue that despite of its significant place in identity of a region or place, village or city and also the people, landscape is commonly not treated seriously which results into poor narrative in the film concerned and ultimately the message conveyed. Through this paper we have tried to critically analyse the landscape representation in cinema which reflects the society, culture and various identities. While the concept of landscape is complex one but its wider canvas includes territories between cities, streets, television sets and geographical imagination. Landscape representation in cinema undeniably shapes the nature of human settlements as well as the culture and identity of the society. The historical development and the changes occurred in landscape representation and city developments have been found going side by side, particularly in the western context. With the passage of time, the concept of virtual space gained its due place in landscape representation in cinema. The development of sense of place with the development of cinema has some spatial significance which should be the subject matter of pedagogical discourse in cultural geography, to be more specific film geography. Bollywood, along with regional cinema in India, is highly productive, covering a wide array of themes, historical as well as contemporary, awaiting geographical analysis particularly by the Indian geographers. Such enterprises will not only enrich cultural geographic studies in India but could potently help in developing/using films as a pedagogical tool in geography classrooms.

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A Review of Urban Microclimate Concepts and Thermal Indices in the Analysis of Outdoor Thermal Comfort in Tropical Humid Climate -Case Study on Kolkata

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Abstract : *This paper highlights the need of study of urban microclimate at neighbourhood scale in order to understand the thermal conditions of a city based on urban microclimatic parameters. The paper briefly describes the aspects of biometeorology, urban microclimate and the elements in the urban atmospheric layer where microclimatic parameters such as temperature, humidity, wind speed play an important role. These parameters along with the human clothing patterns and metabolic activity help in understanding the outdoor thermal comfort condition. The thermal condition of the city coupled with the thermal sensation can be used in future urban planning policies. The study intends to showcase the impact of the microclimate parameters on outdoor thermal comfort through Physiological Equivalent Temperature Standard Effective Temperature, Wet Bulb Globe Temperature and Predicted Mean Vote. In this study, the RayMan 2.1 software has been used to calculate outdoor thermal comfort.[1, 2, 4]. The study during late-March,2019, shows the result in variability of thermal comfort data calculated from the four indices. Standard Deviation and Variance show that PET and SET show maximum variability of data. Since the different stations have different micro-climate conditions, the variability of data in terms of deviation from the average is best shown by PET and SET thermal comfort indices. Also the VDI, German Institute of Engineers, recommend the use of PET in a wide range of microclimate conditions. Hence, PET is considered most appropriate for further studies in the analysis of outdoor thermal comfort. Furthur use of the PET index can help delineate areas in the city that are comfortable and thus can be a key in sustainable urban and regional planning process.*

Keywords : *Urban Microclimate, Thermal Indices, Thermal Sensation, Outdoor Thermal Comfort, Sustainable urban planning*

Introduction

Biometeorology studies the influence of climate conditions and changes upon the ecosystem. Human biometeorology deals with the influence of environment upon human beings. Human Biometeorology has been studied since Hippokrates (400 BC) to Alexander von Humboldt (1827), Kant to many more. Fanger (1970) described the Predicted Mean Vote (PMV) derived from his comfort equation. To study the impact of climate change conditions on human activity and conversely

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the influence of changing metabolic rate resulting in decreasing or increasing body temperature resulted in the need for bioclimatic indices. Most of such indices were based on heat balance equation The values can be represented spatially in bioclimatic maps at different scales of study: city, neighbourhood, block and so on. The 'Verein Deutscher Ingenieure' (VDI, 1996), Germany was the first to set a guideline on 'Human-biometeorological assessment of climate and air pollution for urban and regional planning' and recommends the use of energy balance models such as of the thermal component of the bioclimate (Höppe, Aspects of human biometeorology in past, present and future, 1997). The following study gives a review of the concepts in urban microclimate and the development of thermal comfort indices. The thermal indices of WBGT, PMV, SET and PET along with the thermal sensation scale helps to understand the conditions of heat strain. The study of microclimate and thermal comfort is relatively new in our country. Thermal indices have long been in use in other nations along with the building of bioclimatic maps. The use of thermal comfort index is a growing area with many new studies (Chowa, Assyakirin Binte Ali Akbara, Heng, & Roth, 2016) (Fang, Jiang, & Guo, 2015) (Koerniawan, 2015) (Mills, 2015) (Mukherjee & Mahanta, 2014) and more

Urban Microclimate

Urban Microclimate is a resultant of 'Form and Function of a city' (Mills, 2015) ; land use and surface characteristics (Fang, Jiang, & Guo, 2015), Urban Geometry (Ng, Urban climatic map studies in China: Hong Kong, 2015), geography of a city ,both physical and socio-economic (ANDRADE, NERY, MOURA, & KATZSCHNER, 2015), trees and building typology (Oke T. R., Mills, Christen, & Voogt, 2017)and local climate (Taha, 1997). Microclimate can extend from a few meters to tens of kilometres. Areas with similar microclimate can be grouped into climatopes. Climatopes refers to the near-surface climate conditions which may be considered for planning purpose. Microclimate extends from 10mm to 1km. The urban climate events mostly take place in the micro-scale, local scale and meso-scale though the transition between the layers is not distinct. Urban Boundary Layers is made up of several combined microclimate features. The lowest 10% of the Atmospheric Boundary layer forms the surface layer with sufficient turbulence. The convective circulation during daytime, from the surface layer to the top of the Atmospheric Boundary Layer and back to the surface layer, creates mixing of air and creates a homogeneous nature so that the other climate parameters, such as wind, humidity and so on, may show a pattern. The surface layer has two parts of which the roughness sub layer is most responsible for all the friction taking due to surface roughness. (Oke T. R., Mills, Christen, & Voogt, 2017)

Outdoor Thermal Comfort

Thermal comfort is the condition of the mind that expresses satisfaction with the surrounding environment. Outdoor thermal comfort concerns itself with outdoor thermal conditions. (Epstein & S.Moran, 2006) (ASHRAE, 2010) (Hooi Chyee Toea & Kubota, 2013) In 1938, Buttner recognised the need to consider the combined effect of several parameters to understand the influence of environment upon thermal sensation of people. (Höppe, The physiological equivalent temperature – a universal index for the biometeorological assessment of the thermal environment, 1999) Fanger

in his book 'Thermal Comfort' showed six parameters that affect human response; air temperature, radiant temperature, relative humidity, wind speed, metabolic heat from human activity and clothing conditions. Temperature determines the heat flow between human being and the surrounding air. Heat exchange by radiation is described by the mean radiant temperature which is the temperature of a uniform experimental enclosure having exchange of heat by radiation in the same way as it does in the real world environment. (Parsons, Human Thermal Environments- The effects of hot, moderate and cold envieonments on human health, comfort and performance, 2002)This parameter is instrumental in the calculation of thermal comfort through PET. (Matzarakis & Amelung, Physiological Equivalent Temperature as Indicator for Impacts of Climate Change on Thermal Comfort of Humans) (Walikewitz, Janicke, Langner, Meier, & Endlicher, 2015) Metabolic rate increased by 17.5 Watt due to equivalent rise in air temperature by 1degree Celsius. Clothing Insulation shows 1 clo change to a change of air temperature by 5 degree Celsius while at resting condition and 10 degree Celsius while exercising. (Epstein & S.Moran, 2006)

Indices for outdoor thermal comfort

Many thermal indices and thermal models were developed in the late 20th century to estimate the influence of thermal environment on humans. Indices such as Heat stress index, Discomfort index by Thom, 1959, Wind-chill index by Steadman, 1971 did not include the effect of heat exchange by radiation fluxes or human physiologic heat regulatory system which was later considered by Mayer 1987, and Höppe, 1999. (Grigorieva & Matzarakis) For an index to be applicable it must be practical and accurate at various study conditions; it must consider all the important environmental as well as physiological parameter; the index values must show threshold for safety limits of the thermal conditions in regard to health risk and proper measurements to reflect appropriate thermal conditions of a worker (Epstein & S.Moran, 2006) and the need for such precautionary threshold values was first given by Lee (1980). Lee also said that an index must provide room from acclimitization in indoor conditions such as an office. He said that the limits to comfort must be defined; also past experiences in different environments must be considered. Lee also mentioned the need to choose between the better option of forced environment with windspeed control and temperature- humidity control v/s the natural environement. Finally , he also mentioned that Climate classification cannot always be the only classification. By considering the thermal sensation of the people in terms of comfort or stress can be a useful way to classify zones. (Auliciems & Szokolay, 2007).

Thermal comfort indices or heat stress indices can be rational (using heat balance equation), direct (using direct measurements), empirical (objective and subjective stress). Though the rational index is most comprehensive but the direct index is most practical in its application in various thermal conditions provided the necessary guidelines are adhered to (Epstein & S.Moran, 2006). Houghton and Yaglou introduced the Effective Temperature in 1923 to understand the effect of air temperature and relative humidity relative to comfort conditions. The effective temperature was modified to corrected effective temperature (CET) when the dry bulb thermomter was replaced with a black globe thermometer to include readings of radiation. From the CET emerged the WBGT. The Oxford Index was introduced in 1957 after applying weightages on wet bulb and dry bulb temperature.

This helped to understand how evaporation of sweat helps in thermoregulation of human body. (Epstein & S.Moran, 2006)

Thermal Indices- PMV,PET, SET,WBGT

The Wet-Bulb Globe Temperature (WBGT) is most used around the world. It was developed by the US Navy to understand the heat related health issues during training. It was adopted as an ISO (ISO 7243) standard. It came from the Corrected Effective Temperature (CET) that includes parameters such as dry bulb temperature(Ta), wet bulb temperature(Tw) , black globe temperature (Tg) in Equation 1 (Epstein & S.Moran, 2006) (Auliciems & Szokolay, 2007). The WBGT index can be 'cumbersome'. (Epstein & S.Moran, 2006) The WBGT is denoted by flags of different colours which show the category of heat in the region. As shown in Table 1.

Table 1 Sensation scale of WBGT Heat Strain Index.

WBGT	Flag Colour	WBGT	Flag Colour
<=25.6-27.7	White	31.1-32.1	Red
27.8- 29.4	Green	>=32.2	Black
29.4-31.0	Yellow		

WBGT=0.7Tw+0.1Ta+0.2Tg.....Eq.1

The Direct Index (DI) was developed by Thom and slightly modified by Sohar. The index is given by Equation2 (Epstein & S.Moran, 2006).

DI=0.5Tg+0.5Ta.....Eq.2

Fanger proposed the Predicted Mean Vote(PMV) and the Predicted Percentage Dissatisfied (PPD). Both are quite similar and based on heat transfer from clothing to skin to the surrounding air and includes respiratory heat transfer. (Szokolay, 1997). PMV developed by Fanger (1972), is applied in International Organization for Standardization (ISO) 7730. PMV is a seven point scale ranging from very cold to very hot and also includes metabolic rate and clo valuesapart from environmental parameters. For an area to be thermally acceptable, the percentage of dissatisfied people must be less than 10% (ISO 7730, 1994) (Koerniawan, 2015). To apply the PMV outdoors, Jendritzky and Nubler (1981) added 'complex outdoor radiation' ; naming the index Klima-MichelModel (KMM). Matzarakis and Mayer (1997) calculated PMV and selected PMV along with with KMM which is a 'well-suited measure' for measuring outdoor thermal comfort condition. (Mukherjee & Mahanta, 2014). PMV is expressed in the ASHRAE comfort scale.

Physiological Equivalent Temperature (PET) is calculated using the MEMI (Munich Energy-balance Model for Individuals; Höppe 1984)model by solving Equation 3 and Equation 4 where M - metabolic rate (internal energy production), W - physical work output, R - net radiation of the body, C -the convective heat flow,ED- the latent heat flow to evaporate water diffusing through the skin (imperceptible perspiration), E_{re} - sum of heat flows for heating and humidifying the inspired air, E_{Sw} the heat flow due to evaporation of sweat, and S - storage heat flow for heating or cooling

the body mass (Mayer & Matzarakis, Human-biometeorological assessment of urban microclimates thermal component, 1998) .

$M .W.R .C .E_D.E._{Re}E_{Sw}S = 0$.....Eq. 3

$FSC=(1/Icl)*(Tsk–Tcl)$.....Eq.4

Where *T*cl= mean surface temperature of the clothing , *T*sk= the mean skin temperature , *F*CS = the heat flows from body core to skin surface, Icl = heat resistance of the clothing in K m2 W–1 . (Höppe, The physiological equivalent temperature – a universal index for the biometeorological assessment of the thermal environment, 1999).

PET has the following assumptions: Mean radiant temperature = air temperature (Tmrt =Ta); Air velocity = 0.1 m/s. Water, vapour pressure = 12 hPa which is equivalent to relative humidity (RH)= 50% at 20°C Ta. (Mukherjee & Mahanta, 2014). The Thermal sensation vote and grade of physiological stress for PMV and PET is shown in Table2.

Table 2 Sensation scale for PMV and PET ((Höppe, The physiological equivalent temperature – a universal index for the biometeorological assessment of the thermal environment, 1999)

PMV (Degree Celsius)	PET (Degree Celsius)	Thermal Perception	Grade of Physiological Stress
		Very Cold	Extreme cold stress
-3.5	4		
		Cold	Strong cold stress
-2.5	8		
		Cool	Moderate cold stress
-1.5	13		
		Slightly Cool	Slight cold stress
-0.5	18		
		Comfortable	No thermal stress
0.5	23		
		Slightly Warm	Slight heat stress
1.5	29		
		Warm	Moderate heat stress
2.5	35		
		Hot	Strong heat stress
3.5	41		
		Very Hot	Extreme heat stress

The advantage of PET is that it is calculated in degree Celsius and can be calculated in an array of microclimatic conditions including those in built up areas and other urban surface cover. PET is recommended by the new German guidelines for Urban and Regional Planners (VDI, 1998). It is easily calculated by using the software RayMan developed by Matzarakis et al. (2007and PETcan be used to produce bioclimatic maps. (Grigorieva & Matzarakis) (Mukherjee & Mahanta, 2014).

One of the most important parameters for calculation of PET , on days with weak wind speed, is the mean radiant temperature (Tmrt) (Mayer and Matzarakis 1998). The ranges of the thermal stress for PET is derived from PMV values, (VDI 1998) Fanger (1972), and they depend on clo values and metabolic heat flow . However, one may question , if the values of the range can be adjusted in accordance to the sensation and perception of human beings to the changing environment conditions (Matzarakis, Mayer, & Iziomon, Applications of a universal thermal index: physiological equivalent temperature, 1999)

Standard Effective Temperature (SET) by Gagge et al.(1986) is a 'sub-set' of ET within conditions standardized in terms of metabolic rate, clothing conditions. SET has a linear relation with average body temperature (Tb) and at equilibrium temperature (between 23-41 degree Celsisus), SET is determined by Equation 5 & 6. Equation 5 for temperature below 23 degree Celsius and Equation 6 for temperatures above 41 degree Celsius. (Auliciems & Szokolay, 2007)

$$SET = 23 - 6.13\,(36.4\text{-}Tb)^{0.7} \ldots\ldots\ldots \text{Eq.5}$$

$$SET = 41 + 5.58\,(Tb\text{-}36.9)^{0.87} \ldots\ldots\ldots \text{Eq.6}$$

Table 3 Thermal Sensation scale for SET, ASHRAE, Bedford

Vote	Senastion	SET	Vote	ASHRAE	Bedford
>3	Very hot	>37.5	3	Hot	Much Too Warm
+2 – +3	Hot	37.5–34.5	2	Warm	Too Warm
+1 – +2	Warm	34.5–30	1	Slightly Warm	Comfortably Warm
+0.5 – +1	Slightly warm	30–25.6	0	Neutral	Comfortable
-0.5 – +0.5	comfortable	25.6–22.2	–1	Slightly Cool	Comfortably Cool
-1 – -0.5	Slightly cool	22.2–17.5	–2	Cool	Too Cool
-2 – -1	Cool	17.5–14.5	–3	Cold	Much Too
-3 – -2	cold	14.5–10			Cool

SET for outdoor conditions is called OUT-SET (Pickup & de Dear) (Gagge., 1969). The assumptions in SET are Ta = Tmrt, rh = 50 %,n = 0.15 m/s ,0.6 clo , metabolic rate of 1.2 mets and the same mean skin temperature (*tsk*) = skin wettedness (*w*). (Pickup & de Dear) . The Thermal sensation

vote and grade of physiological stress for SET, ASHRAE and Bedford Heat stress/Thermal Comfort Index is shown in Table3.

Case study of Kolkata

Apart from air temeperature and surface temperature, other meteorological parameters are important in the analysis of outdoor thermal comfort 'especially that of site microclimates'. (Chowa, Assyakirin Binte Ali Akbara, Heng, & Roth, 2016) This paper studies the microclimate conditions in Kolkata and show the thermal conditions by the different indices in order to understand the range of values presented in the study of outdoor thermal comfort. Kolkata has a tropical wet and dry climate in accordance to the Koppen climate classification. Kolkata (22.34'N and 88.24'E) is located on the banks of River Hooghly with an elevation of 6m above msl.

The study area shows 41 locations based on road intersections of east-west and north-south arterial roadways in the city municipal area as shown in Figure 1.

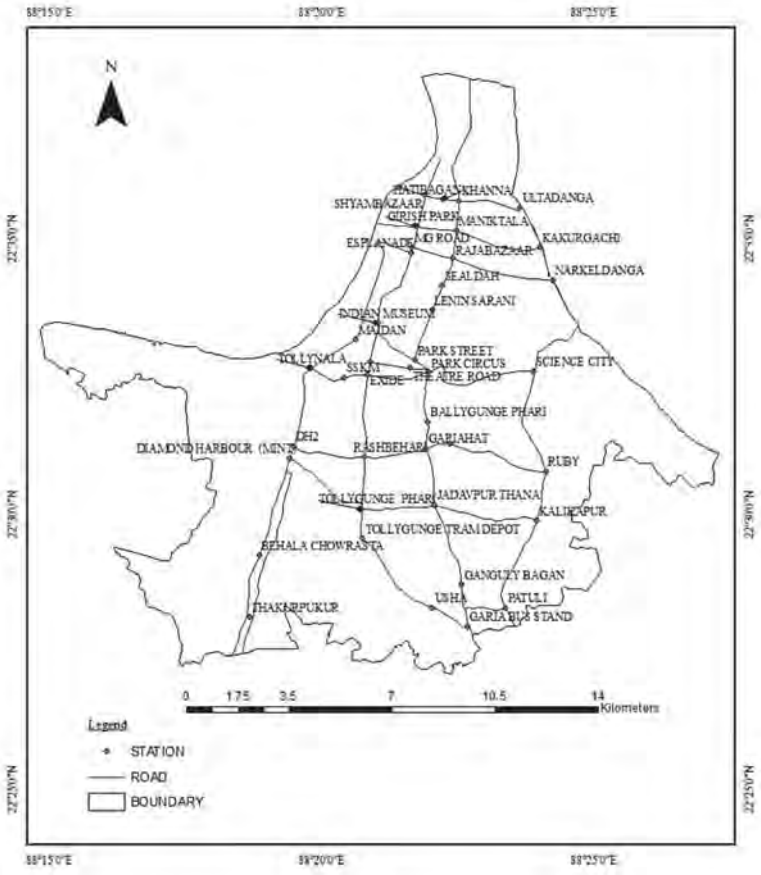

Fig. 1 Showing the Study area and Data Collection stations

Methodology

The primary data was taken for 41 stations. WBGT , RH, Ta and Tg are measured at 2 minute interval. The anemometer and Black-Globe thermometer was set at 1 m above the ground. An average of 30 minute interval readings for the parameters were taken . The details of the instruments are mentioned in Table 4. The instrument setup were done according to the regulations mentioned in ISO 7726. Calculation of Tmrt requires using the primary urban microclimate data on temperature, relative humidity, wind speed and globe temperature. The Tmrt is calculated using the globe thermometer method. (Walikewitz, Janicke, Langner, Meier, & Endlicher, 2015)(Thorsson, Lindberg, Eliasson, & Holmer, Different Methods for estimating the mean radiant temperature in an outdoor urban setting, 2007). The microclimate data also helps to calculate PMV and SET values in RayMAN pro model, version 2.1 . WBGT is calculated using the Extech Heat Stress Meter (HT30). The resultant values were then analysed on SPSS for mean deviations and standard deviations.

Instrument used

EXTECH Heat stress WBGT Meter(HT30) with range 0° to 50°C and sensor accuracy of 1°C for the parameter Ta. Tg also measured with the same instrument with range of 0° to 80°C and sensor accuracy of 3°C. RH measured with the same heat stress meter with range of 1-100% and sensor accuracy of +/-3%. Wind velocity measured within range of 0.80m/s to 30.0m/s with sensor accuracy of ±(0.05 + 0.05 va) m/s (COMFORT); ±(0.1 + 0.05 va) m/s (STRESS). Global Solar Radiation & Albedo is measured with Hukseflux SRA01 Second Class Albedometer (ISO 9060) Directional response < ± 25 W/m^{2}Spectral selectivity < ± 5 % (0.35 to 1.5 x 10-6 m) Temperature response < ± 3 % (-10 to +40 °C)Tilt response < ± 2 % (0 to 90 ° a t 1000 W/m^2)

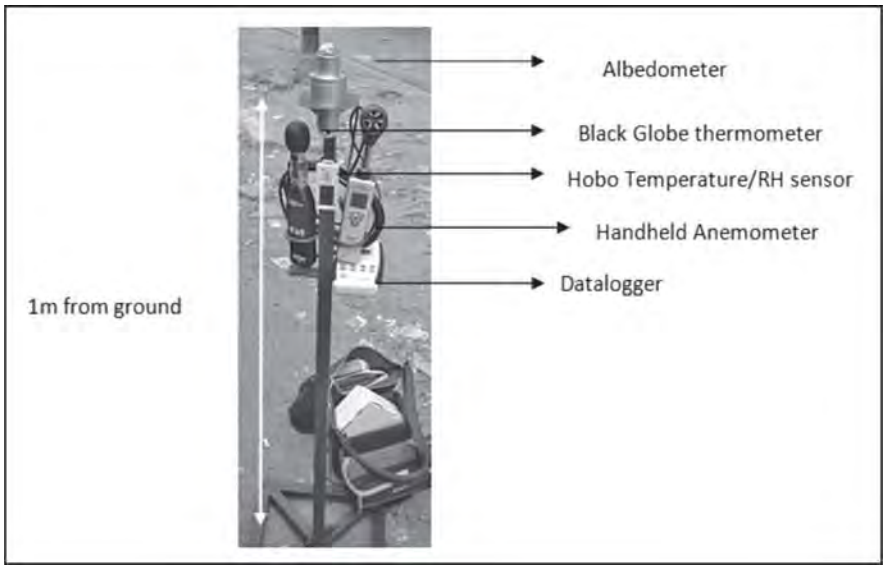

Figure 2 showing the instrument set up for data collection of urban microclimate parameters

The limitations of data collection are the unavailability of secondary data for urban microclimate parameters at pedestrian level of 1-2m. The instrument setup is given in Figure 2. All data was collected for the period of late-March, 2019, around the time of vernal equinox, from 12:00 pm to 1:00 pm.

Results and Discussion

The range of data is 4.70 for PMV, 24.00 for PET, 21 for SET and 4.20 for WBGT. This shows that PET has the highest range of data followed by SET, PMV, and WBGT. The standard deviation is 1.45, 6.51, 8.46, and 2.14 respectively for PMV, PET, SET and WBGT. The variance for the same data is 2.11, 42.32, 71.61 and 4.58 for PMV, PET, SET and WBGT. Variability of data and standard deviation is maximum for SET followed by PET Figures 3 show that PET have high frequency of values in the range of 29-35 degree Celsius denoting Warm thermal sensation.

Table 4: Showing the values for Standard Deviation, Variance, Mean and Range for the four indices: PMV, PET, SET, WBGT

	PMV	PET	SET	WBGT
Mean	2.63	32.79	25.96	21.73
n	41.00	41.00	41.00	41.00
Variance	2.11	42.32	71.61	4.58
SD	1.45	6.51	8.46	2.14

Figure 5 show that PMV have high frequency values within the range of 1.5 -2.5 sensation vote which represents Warm thermal sensation. Figure 6 shows that one station with comfortable conditions and 23 stations having warm conditions according to the PET thermal sensation scale, 9 stations have slightly warm sensation, 3 have hot and 5 have very hot thermal sensation. Figure 7 shows that according to the PMV sensation vote, 7 stations have slightly warm condition. 21 stations have warm sensation 11 stations have hot sensation on PMV scale and 1 station have hot sensation. The values from SET, show that 17 stations have slightly cool to cool conditions and 25 comfortable and only 13 stations ranging from slightly warm to very hot. WBGT did not show much variation in data and thus a clear difference in microclimate

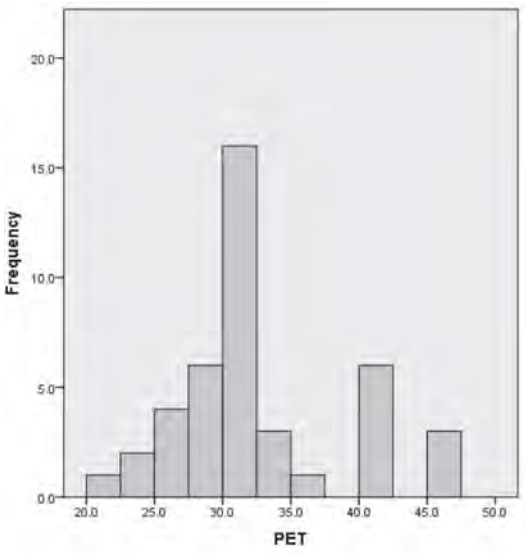

Figure 3 : Histogram showing the frequency distribution of PET values of 41 stations

conditions and thermal sensation could not be presented. The study period is during late March, 2019 during which the average temperature at 1.5 m pedestrian level is 30 degree Celsius and the Relative Humidity is 32-35%.

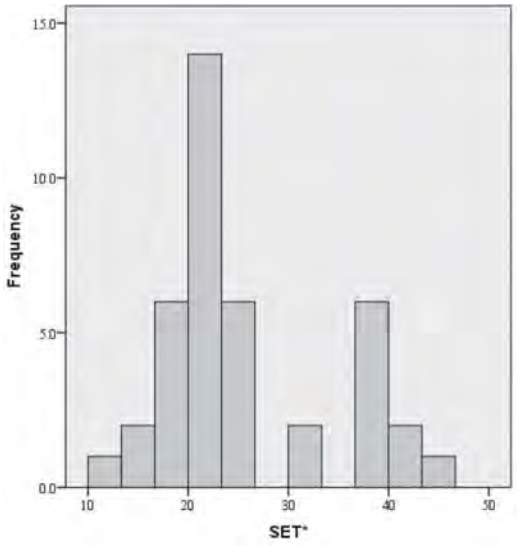

Figure 4 : Histogram showing the frequency distribution of SET values of 41 stations

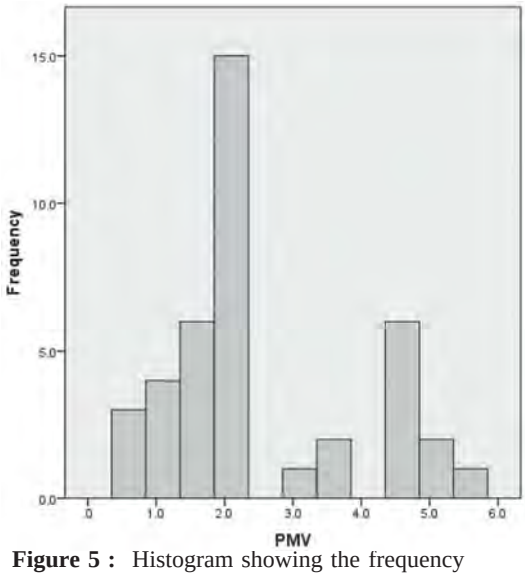

Figure 5 : Histogram showing the frequency distribution of PMV values of 41 stations

From Figures 6, 7 and 8, it is clear that PET provides data for five types of thermal sensation vote which ranges from Comfortable, Warm, Slightly Warm, Hot and Very hot. PMV on the other hand do not record any comfortable conditions and show thermal sensation vote only within the

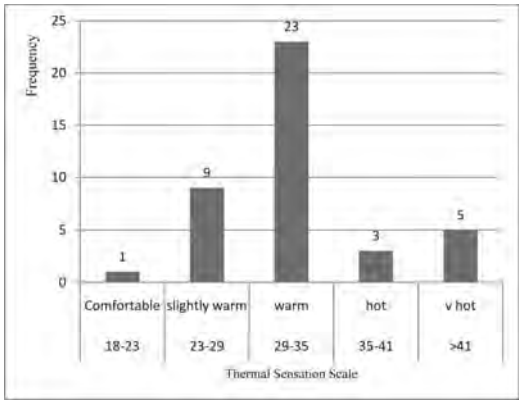

Figure 6: Showing frequency of stations having thermal sensation according to the PET thermal sensation scale; Refer Table 2

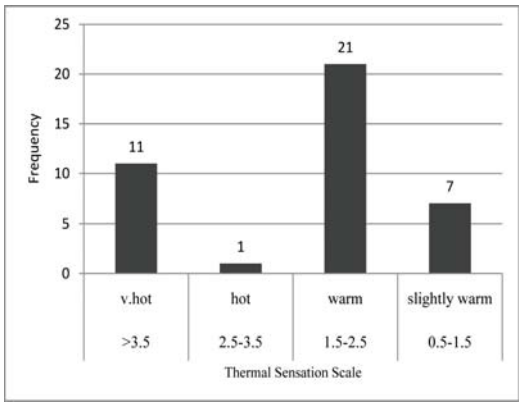

Figure 7: Showing frequency of stations having thermal sensation according to the PMV thermal sensation vote. Refer Table 2

range of Very Hot, Hot, Warm and Slightly Warm. SET provides thermal sensation vote for cool and slightly cool conditions in addition to very hot, hot, slightly warm, warm and comfortable. In the study period of late March 2019, the conditions cannot be described as cool to very cool at pedestrian level in outdoor conditions. PET has maximum incidence of slightly warm conditions, PMV records maximums incidence of warm conditions and SET records maximum incidence of comfortable to cool conditions.

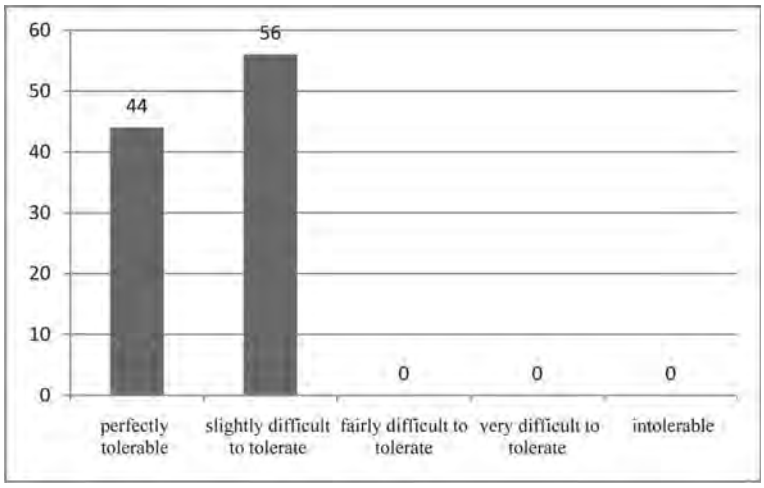

Figure 8: Showing frequency of stations having thermal sensation according to the SET thermal sensation scale. Refer Table 3.

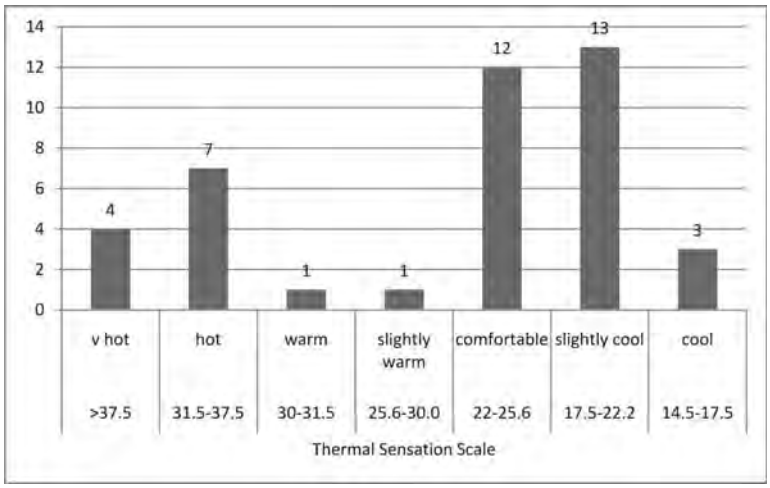

Figure 9 showing frequency of respondents on comfort in the environment from questionnaire survey in March 2019

In order to verify the results from the opinion of the people, a questionaire survey was conducted for 100 sample respondents. The questionnaire schedule is prepared that consist of questions covering opinion on thermal sensation. Thermal sensation includes thermal perception, thermal comfort, thermal preference, thermal acceptability and thermal tolerance. 41 primary stations were selected based on the intersection point of major arterial roads. Foreign visitors were excluded from this survey to avoid exaggeration.

According to the data collected and analysed from the questionnaire survey, Figure 9 shows majority people expressing slight discomfort. Figure 10 shows 56 respondents felt slight difficulty

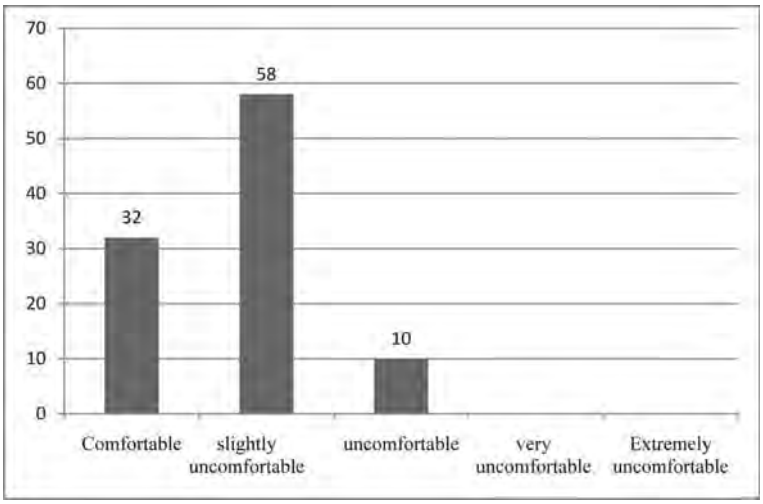

Figure 10 showing frequency of respondents on thermal tolerance in the environment from questionnaire survey in March 2019

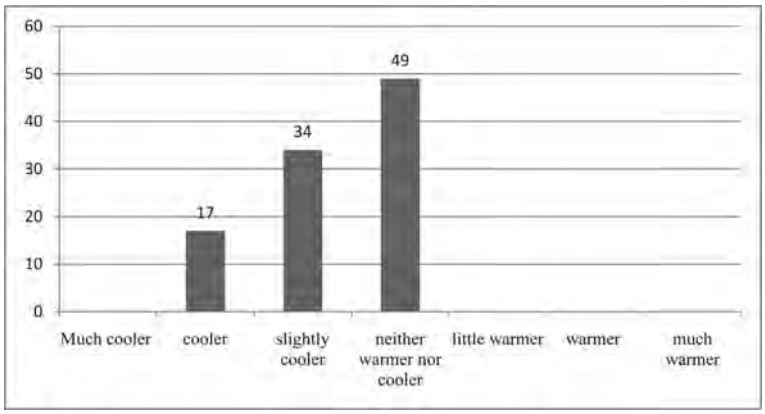

Figure 11 showing frequency of respondents on thermal preference in the environment from questionnaire survey in March 2019

in tolerating the thermal conditions and in Figure 11, 34 persons wanted slightly cooler conditions while 49 respondents wanted no change in the environment. From this questionnaire survey, it is clear that warm to slightly warm conditions prevailed in the duration of study.

Hence results from the study show that PET and PMV give a similar trend in the thermal comfort analysis of the city during the study period. The cool and slightly cool conditions represented by SET has been overlooked after performing the questionaire survey.

Conclusion

Slightly cool conditions derived from SET thermal index does not match with people's response for the period of study in late March,2019. PMV and PET give similar trend in thermal comfort conditions existing in the city. PET is a relatively new index that is recommended by the VDI. It is a recent index, apart from UTCI, that considers clothing patterns and metabolic heat production into consideration. It can also be easily calculated by the RayMan software and EnviMet software. Among the four indices, PET is considered as the thermal comfort index for further use in the analysis of outdoor thermal comfort in the subtropical microclimate conditions in the city of Kolkata.

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Development of Subarnarekha Riverbed Potholes in Ghatshila, East Singhbhum District, Jharkhand

Rupam Kumar Dutta[1] and Bandita Buragohain[2]

Abstract : *Recently, most of the scientists have emphasized on controlling factors of channel pothole formation in different parts of India with special reference to structural role for developmental of potholes. They have hardly focused on the change detection study of this micro fluvial geomorphic features. The present researchers have tried to illustrate the development of channel pothole at the confluence of Subarnarekha and its tributary Lokjeria river bed(channel outcrop) near Rajbari, Ghatshila , East Singhbhum district of Jharkhand in India with a change detection study of temporal data (2013 &2019) on different geometrical parameters (major diameter, minor diameter, depth of pothole, shape etc.) of pothole .Change detection study on development of pothole with spatio-temporal data is an important approach in fluvial geomorphology specially for the understanding of pothole dynamics. Developments of potholes are related to the geology, geomorphology, flow patterns of the river and other local factors. These micro-relief features specially along the river valleys reflect the tectonic control of base level consistent with rejuvenation of the drainage system in Subarnarekha basin .Episodically, both deepening and widening mechanism develop shape of potholes after that, coalescence of adjoining potholes is occurred and ultimately collapses causing valley deepening to maintain the channel equilibrium in the longitudinal profile of a river.*

Keywords : *Change detection, Pothole dynamics, Coalescence, Channel equilibrium.*

Introduction

The present paper deals with the channel form of Subarnarekha river with special reference to development of potholes at the confluence of Subarnarekha and its tributary Lokjeria river bed(channel outcrop) near Rajbari, Ghatshila ,East Singhbhum district of Jharkhand in India. Channelform which is very dynamic in nature is altered under the influence of different controlling factors such as stream energy, stream bed lithology, sediment types and flow properties etc. Many scientists have emphasized on various controlling factors of channel pothole formation in different parts of Subarnarekha valley. They have given special emphasis on structural role for developmental of potholes but the present work has some objectives which are different from the earlier works. The authors think that there is a need to analyze different temporal data of pothole for the study of their sequential change. Hence the present investigators have focused on the change detection study

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of the micro fluvial geomorphic features and as well as their gradual progress of shape. The researchers have tried to illustrate the sequential development of channel pothole with a change detection study using temporal data (2013 &2019) on different geometrical parameters (major diameter, minor diameter, depth of pothole, shape etc.) of potholes. Potholes may be formed by evorsion that is a kind of corrasion that states the mechanical wearing a way of land, generally by the impact or grinding action of particles carried by stream (Moriswa, 1968). The twenty- five potholes have been selected as samples of the present study. The study has also revealed that the different geometrical parameters of the selected potholes have been changed in the last 6 years indicating pothole dynamics.

The study area

The study area situated at the confluence of Subarnarekha and its tributary Lokjeria river near Rajbari, Ghatshila , East Singhbhum district of Jharkhand in India. (fig.1). In this study twenty five potholes samples have been taken to measure different parameters like; major diameter, minor diameter, depth, shape, pothole materials etc including their latitude and longitude.

The Subarnarekha basin has been an area of noted repeated rejuvenation during Tertiary period and it caused fresh adjustments to the evolved fluvial condition which is an important cause for such formation of potholes over the channel bed-rock (channel outcrop) along the Subarnarekha and its tributaries. So,Subarnarekha river characterized with channel outcrop has favourable condition specifically for the development of pothole. That is why the present researchers have selected potholes at the confluence of Subarnarekha and its tributary Lokjeria river near Rajbari, Ghatshila as the area under study.

Objective

The objectives of the present paper is to explain the development of potholes at the confluence of Subarnarekha and Lokjeria river, Ghatshila, with quantitative techniques and focus on change detection analysis of pothole geometry depending on the field data from 2013 to 2019.

Significance of the study

Fluvial geomorphologists always try to understand rivers-their morphology and dynamics. They want to explain quantitatively the processes by which running water develops different fluvial landforms. The researchers think that there are several reasons to study pothole development in Subarnarekha river valley. Channel pothole has a great significance in fluvial geomorphological perspective because those landforms are thought as micro fluvial features which are the prominent geomorphic expression of rejuvenated landscape. Being micro geomorphic feature it is easier to study their dynamics and evolutionary stages within a comparatively short time span (within few years). Studies about their chronological development will help to understand the channel adjustment to the evolved circumstances of the rejuvenated Subarnarekha river valley that suggests the dominance of tectonic activities and down cutting process in the evolution of the present river bed-rock (channel outcrop) as well as topographic forms.

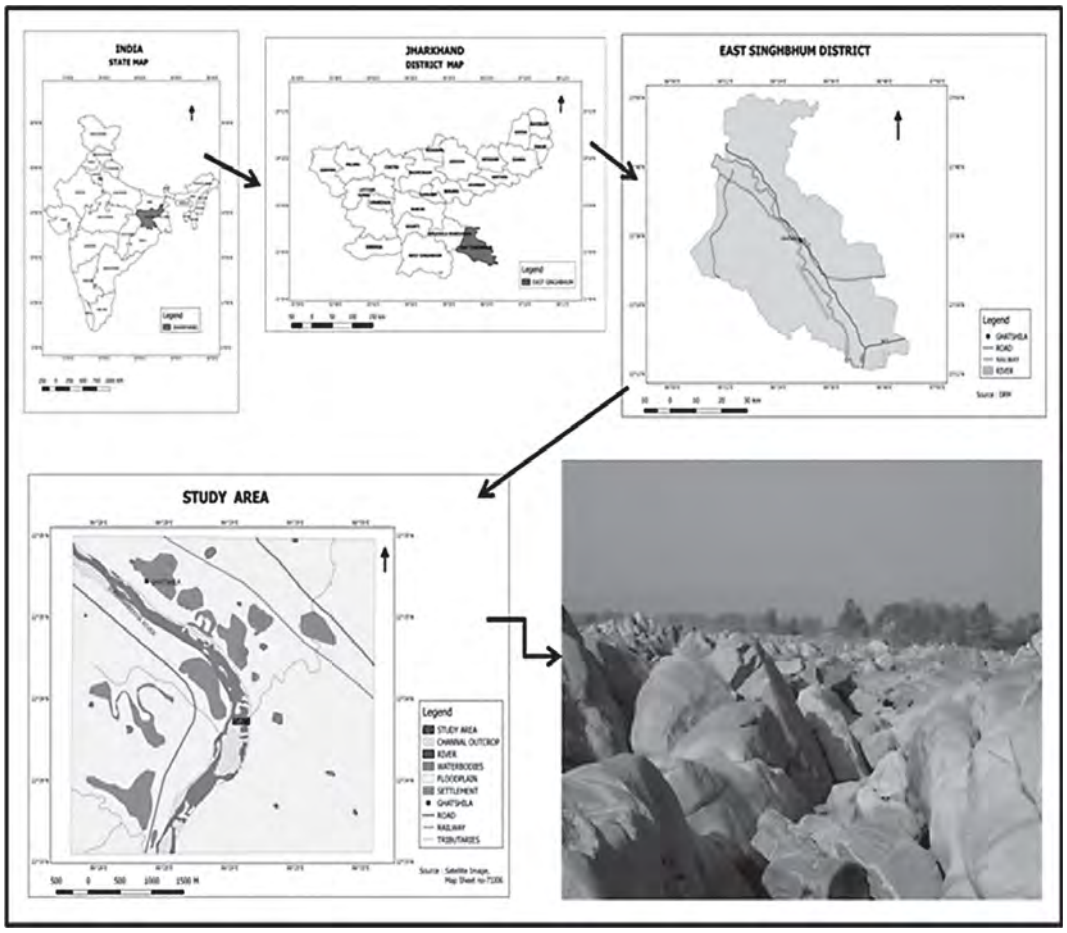

Fig.1 Study area at the confluence of Subarnarekha and its tributary Lokjeria river indicating channel outcrop characterized with river potholes (source- DRM, GSI, toposheet 73 J/6, field survey 2019)

Materials and Methods

The study is based on data collected from primary and secondary sources. There are definite purpose for using of secondary data like; District Resource Map of East Singhbhum (GSI,2006) has been used to prepare location map . The geological map of the district has provided better understanding about the setting of rocks and mineral types in Ghatshila and its adjacent area to relate pothole location with geological structure. Survey of India Toposheet (73 J/6), has been utilized to show the spatial location of the study area. In this paper, illustration of Satellite Image (Google earth, 2018) has a significant role to show spatial location of twenty-five potholes according to their geographical coordinates (collected with GPS receiver) .The present researchers have also

consulted different research papers of reputed journals to study the trend of research on pothole and find out gap in the research of the earlier scientists.

In this study more emphasis has been given on primary data collected from intensive field work and photographic evidences. Primary data has been collected from selected twenty- five potholes of the study area in the month of March of 2013 and 2019 . During this month most of the part of Subarnarekha channel remains dry which is the favourable condition for pothole study. In the year 2013 first survey was conducted. Latitude and longitude of selected potholes were collected with GPS receiver for locating the selected potholes in map (fig.2). According to the requirement of the objective of the study, primary data was collected regarding pothole geometry like; major and minor diameter of pothole, depth, shape of potholes, angle of pothole chamber-wall have been measured with the help of tape and clinometers. Facial shape of potholes was identified and recorded with photographic evidences. Materials of pothole chambers(stones,water) were also studied during field visit. Some of the pothole chambers were entirely dry with stones and few of them contained water with stones.However, Second field visit was done again in March,2019. According to the location map of potholes on Google earth image (prepared in2013) the potholes were identified and same geometric data of potholes was collected with same fashion and same instruments to make a compare between the dataset.

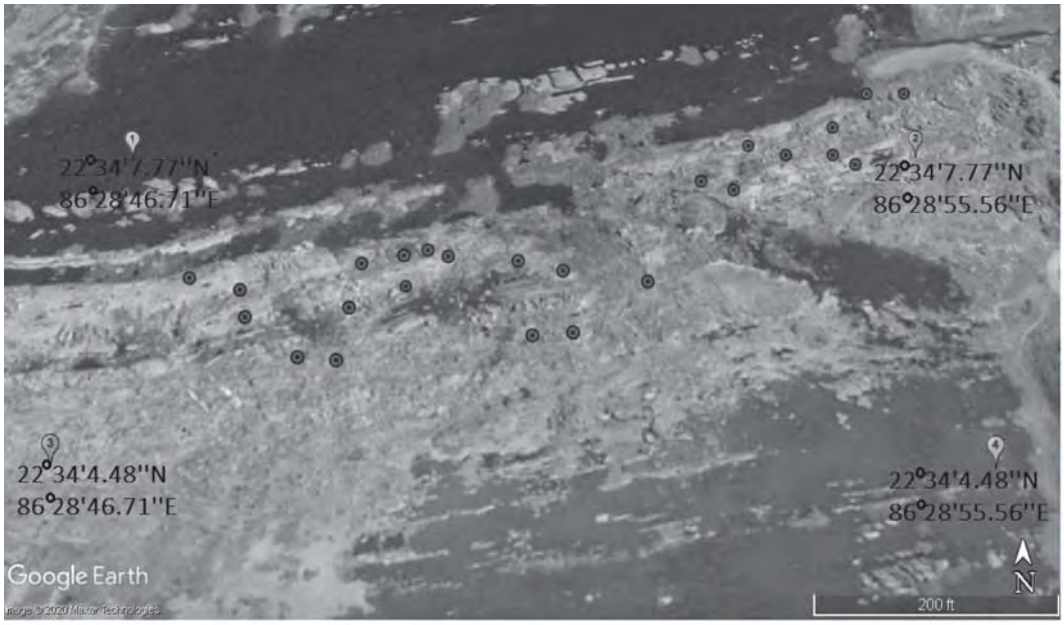

Fig.2 Location of potholes on Google earth image 2018 (*Source: GPS data collected during field survey 2013 &2019*)

For the better analysis potholes are arranged according to serial number (Table -1 & Fig-4) in data table and then collected data (different geometric parameters) have been tabulated to categorize

the potholes. Statistical techniques including measures of central tendency and measures of dispersion have been calculated depending on the collected primary data like; length (major diameter), width (minor diameter), depth. Bivariate analysis has also been done between average depth and average diameter of potholes. Thematic map (Fig-3) are used to ascertain the morphological characteristics of potholes with the help of QGIS and MS Excel software.

Review of literature

The Subarnarekha river basin is Geomorphologically well studied area by many researchers. Several scientists have contributed their valuable research on various perspectives of potholes in Subarnarekha and its tributaries . Mukhopadhyay (1980) had done gigantic research on Subarnarekha river basin including micro geomorphic features. Recently most of the scientists like; Sengupta & Kale(2011), Das (2018&2019), have emphasized on structural role for developmental of potholes. Dhali&Biswas (2017) discussed vividly the local controlling factors for pothole development with Multi Criteria Analysis (MCA). Bera & others (2019) have illustrated pothole dynamics of Subarnarekha river and its tributaries with statistical analysis. Other scientists (Kanhaiya& et.al.,2019) have stressed on influence of structural control over different shape of potholes. However, The present authors have identified research gap in the work of the earlier scientists. The current work is different from earlier works interms of temporal change detection study of pothole geometry as well as the sequential development of pothole shape. None of the earlier scientists had emphasized on change detection study on pothole development with temporal data (atleast two years), but the present researchers have explained the development of potholes at the confluence of Subarnarekha and Lokjeria river, Ghatshila, with quantitative techniques and focused on change detection analysis of pothole geometry depending on the field data from 2013 to 2019. So, undoubtedly the present work bears a different signature compare to the earlier research in the field of Subarnarekha channel pothole study . The study on change detection of pothole is very crucial because without the change detection study or temporal data analysis of pothole geometry, proper study on pothole development or pothole dynamics is not possible. As pothole is a very micro fluvial geomorphic features, hence intensive and prolonged field survey are required to collect primary data of different years regarding pothole geometry.

Potholes as geomorphic evidences of Rejuvenation

The typical landforms resulting from interruptions in the fluvial cycle of erosion and rejuvenation include valley in valley, paired terraces (Barik&Dutta, 2013), incised meander etc in the study area. The area is characteristics with different types of micro geomorphic features like valley in valley, river terraces, river bed potholes, potholes in pothole etc. Those micro-relief features especially along the river valleys reflect the tectonic control of base level consistent with rejuvenation of the drainage system in recent time.

It has been studied that the Subarnarekha basin has been an area of noted repeated rejuvenation during Tertiary period and it caused fresh adjustments to the evolved circumstances which is an

important cause for such formation of valley in valley, river terraces of bed-rock type (channel outcrop) along the Subarnarekha and its tributaries. (Mukhopadhyay 1980).

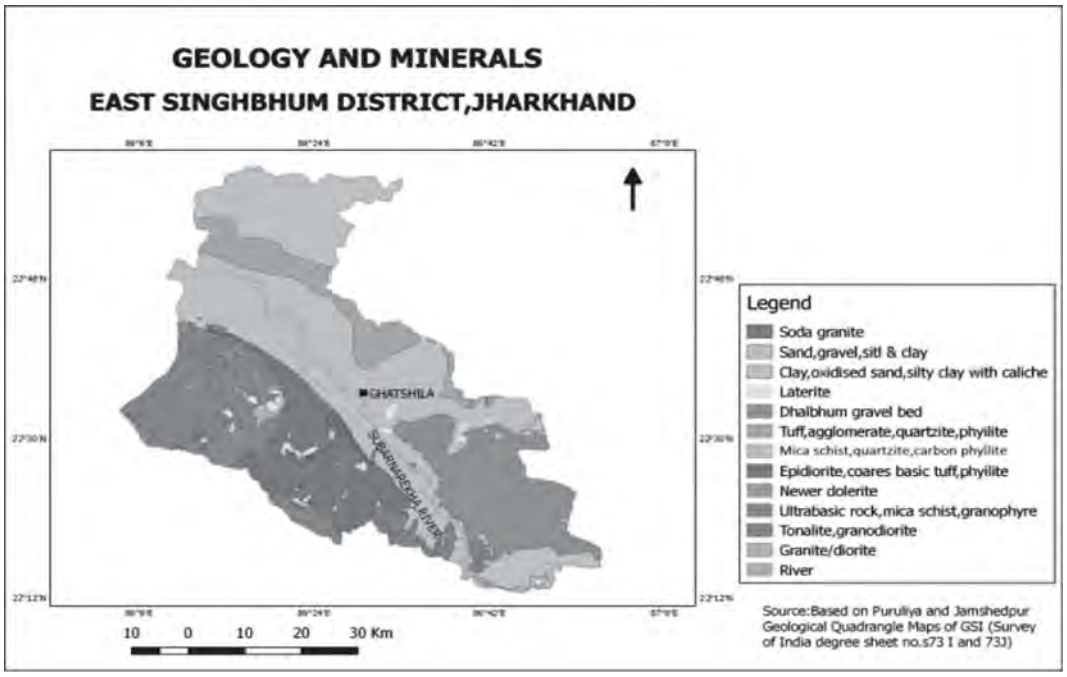

Fig.3 Geological Map of study area *(Source: GSI, 2006)*

Possibly the uplifts took place in several stages since late-Cretaceous. Subarnarekha seems to antedate the current Dalma Range of Chottonagpur plateau made of lavas, thus excavating phyllites and mica-schists on its bed and on its upper slopes lavas have appeared at present. The river has maintained the same extension of valley erosion on the softer phyllite or schsits and resistant quartzite or gneisses after cutting across the Dalma and its adjoining structure (Mukhopadhyay 1980).

Geology and pothole morphometry: East Singhbhum district has remarkably unique geological history of Chottonagpur plateau. Northern part of the district has extremely metamorphosed rocks and southern part of the terrain is characterized with relatively less metamorphosed rocks. The geological formation of this area consists of mainly metamorphosed igneous rocks of Archacan age (GSI, 2006). Surface exposure of schist/phyllite and quartzite of Singhbhum group of rocks are recorded arounded Ghatshila, Jharkhand (Fig.3). Subarnarekha river bed is characterized with two types of metamorphic rock. Foliated metamorphic rocks such as phyllite, schist . Phyllite is made of mainly of very fine grained mica. Non-foliated metamorphic rocks such as quartzite which is comparatively harder rock than phyllite and schist. Lithology and geophysics of substrates

significantly control potholes morphology. Morphometry of potholes on quartzite is significantly different from that on mica-schist. Depth/radius ratio is higher for potholes on hard rocks (plate-1) channel outcrop (quartzite) than on soft rocks like; mica-schist (Das 2019).

Plate1: Deepening and widening lead integration among adjoining potholes over channel outcrop. (*Source: field furvey-2013*)

Results and Discussion

Change direction study of the selected potholes (2013-2019):

Major diameter of potholes (2013-2019): Major diameter of potholes varies from 15 cm to 165cm in 2013 and from 30 cm to 170cm in 2019. In 2013, maximum major diameter of pothole was 165 cm and minimum major diameter of pothole was 15cm. In 2019, maximum major diameter of pothole was 170cm and minimum was 30cm (table.1).

Minor diameter of potholes (2013-2019): Minor diameter of potholes varies from 15 cm to 70 cm in 2013 and from 30 cm to 140cm in 2019. In 2013, maximum minor diameter of pothole was recorded 70 cm and minimum minor diameter of pothole was measured 15cm. In 2019, maximum minor diameter of pothole was found 140cm and minimum was 30cm. (table.1). **Annual erosional rate of major and minor diameters of potholes (2013-2019):** Depending on the data of 2013 and 2019 an approximate annual erosional rate of major and minor diameters of potholes have been calculated. In case of major diameter of potholes, maximum and minimum rate of erosion were respectively 7.5cm/year and 0.5cm/year. For minor diameter of potholes maximum annual erosional rate was 11.66cm and minimum 0.5cm/year (table.1).

Table.1: Collected primary data regarding pothole geometry , 2013 & 2019

Sl. no.	Latitude (N)	Longitude (E)	Major diameter (cm) 2013	Major diameter (cm) 2019	Difference of Major diameter (2013-2019)	Approx Erosional rate of major diameter (cm /year)	Minor diameter (cm) 2013	Minor diameter (cm) 2019	Difference of Minor diameter (2013-2019)	Approx Erosional rate of minor diameter (cm /year)	Depth with pothole materials (cm) 2013	Depth with pothole materials (cm) 2019	Differe-nce of depth of Pothole (2013-2019)	Facial shape of potholes 2019	Facial shape of potholes 2013
1.	22°34´7.41´´	86°28´53.11´´	15	30	+15	2.5	15	30	+15	2.5	70	35	-35	Circular	Circular
2.	22°34´5.45´´	86°28´48.90´´	50	60	+10	1.66	30	41	+11	1.83	90	60	-30	Elongated	Elongated
3.	22° 34´6.47´´	86°28´51.09´´	40	43	+3	0.5	31	34	+3	0.5	80	60	-20	Irregular	Elongated
4.	22° 34´6.24´´	86°28´52.44´´	45	50	+5	0.83	25	35	+10	1.66	30	20	-10	Elongated	Elongated
5.	22° 34´7.62´´	86°28´54.86´´	50	54	+4	0.66	20	39	+19	3.16	2	0.5	-1.5	Less elongated	More elongated
6.	22° 34´7.86´´	86°28´53.69´´	50	56	+6	1	10	35	+25	4.16	20	35	+15	Elongated	linear
7.	22° 34´6.59´´	86°28´50.13´´	30	50	+20	3.33	15	50	+35	5.83	19	100	+81	Circular	Triangular
8.	22° 34´8.10´´	86°28´54.69´´	50	60	+10	1.66	20	34	+14	2.33	6	35	+29	Less Elongated	More Elongated
9.	22° 34´5.56´´	86°28´48.31´´	60	61	+1	0.16	35	37	+2	0.33	50	115	+65	Elongated	Elongated
10.	22° 34´5.96´´	86°28´49.36´´	61	65	+4	0.66	55	62	+7	1.16	80	40	-40	Approx. circular	Approx. circular
11.	22° 34´6.52´´	86°28´50.35´´	63	65	+2	0.33	55	60	+5	0.83	60	35	-25	Approx. circular	Elongated
12.	22° 34´7.74´´	86°28´54.63´´	65	70	+5	0.83	38	40	+2	0.33	30	20	-10	Triangular	Triangular
13.	22° 34´5.67´´	86°28´51.24´´	70	75	+5	0.83	35	40	+5	0.83	85	70	-15	Elongated	Elongated
14.	22° 34´7.74´´	86°28´54.10´´	75	80	+5	0.83	30	33	+3	0.5	50	20	-30	Elongated	Elongated
15.	22° 34´6.15´´	86°28´48.21´´	70	84	+14	2.33	65	66	+1	0.16	140	32	-108	Irregular	Approx. circular

Table.1: Contd..

16.	22° 34´8.56´´	86°28´55.61´´	95	100	+5	0.83	20	60	+40	6.66	70	122	+52	Less elongated	More elongated
17.	22° 34´8.56´´	86°28´55.17´´	90	100	+10	1.66	70	100	+30	5	120	150	+30	Circular	Elongated
18.	22° 34´6.36´´	86°28´51.56´´	90	100	+10	1.66	20	60	+40	6.66	110	60	-50	Less Elongated	More Elongated
19.	22° 34´5.42´´	86°28´49.29´´	90	100	+10	1.66	20	25	+5	0.83	90	70	-20	Elongated	Elongated
20.	22° 34´5.70´´	86°28´51.65´´	75	115	+40	6.66	50	73	+23	3.83	70	72	+2	Elongated	Elongated
21.	22° 34´7.30´´	86°28´53.46´´	95	140	+45	7.5	70	80	+10	1.66	90	100	+10	Elongated	Elongated
22.	22° 34´6.24´´	86°28´48.39´´	115	145	+30	5	90	110	+20	3.33	70	123	+53	Irregular	Elongated
23.	22° 34´6.44´´	86°28´49.44´´	120	145	+25	4.16	90	130	+40	6.66	80	140	+60	Elongated	Elongated
24.	22° 34´6.53´´	86°28´49.88´´	156	162	+6	1	80	115	+35	5.83	55	180	+125	Irregular	Elongated
25.	22° 34´6.28´´	86°28´47.66´´	165	170	+5	0.83	70	140	+70	11.66	90	86	-4	Irregular	Approx circular

Source: Field survey,2013 & 2019

Table.2 Statistical analysis of collected data regarding potholes geometry in 2013 &2019

Sl. No.	Categories	Mean	SD	CV
1.	Major diameter 2013	75.4(cm)	369.38	489.893
2.	Major diameter 2019	87.2(cm)	427.19	489.896
3.	Difference of Major diameter (2013-2019)	11.8(cm)	57.80	489.830
4.	Approx Erosional rate of major diameter	1.8964(cm/year)	9.2904	489.896
5.	Minor diameter 2013	42.36(cm)	207.52	489.896
6.	Minor diameter 2019	61.16(cm)	299.62	489.895
7.	Difference of Minor diameter (2013-2019)	18.80(cm)	92.10	489.893
8.	Approx Erosional rate of minor diameter	3.1292(cm/year)	15.3298	489.897
9.	Depth with pothole materials 2013	66(cm)	324.7	491.9
11.	Depth with pothole materials 2019	71.2(cm)	348.81	489.9
12.	Difference of depth of Pothole(2013-2019)	36.8(cm)	180.45	489.8

Source: Calculated by the authors

Depth of potholes (2013-2019): Depth of potholes (with sediment materials) varies from 2 cm to 140 cm in 2013 and from 0.5 cm to 150cm in 2019.In 2013, maximum depth of pothole was 140 cm and minimum depth of pothole was 2cm. In 2019, maximum depth of pothole was 150cm and minimum was 0.5cm (table.1)(table-2).

Pothole geometry

In general, the potholes are developed on the high-flow regime condition in channel (Wei et al., 2009). The potholes are changed unevenly in size, shape, and depth depending upon flow velocity of the water. This indicates that development of pothole is only related to the geology, geomorphology, and flow patterns of the river (Wei et al., 2009).

According to some scientists (Kanhaiya & et.al.,2019) on the basis of geometry, mainly three types of potholes can be identified in the bedrock channel like; circular elongated, concentric potholes(Kanhaiya & et.al.,2019). Bera & others (2019) have mentioned multidirectional pothole with other types of potholes. The present authors have identified different types of potholes in the study area like; circular, elongated, triangulated, irregular, linear shaped (plate.3) and specially potholes in pothole.

Circular potholes: Absolutely circular type of pothole is very few in number. Circular or closely circular type of potholes occurs where the bedrocks are having veins and also joints/ fractures. In 2013 about 16% of circular type (including approximately circular) potholes have been observed during field survey. This type of pothole occurs when the swirling water spins the load of

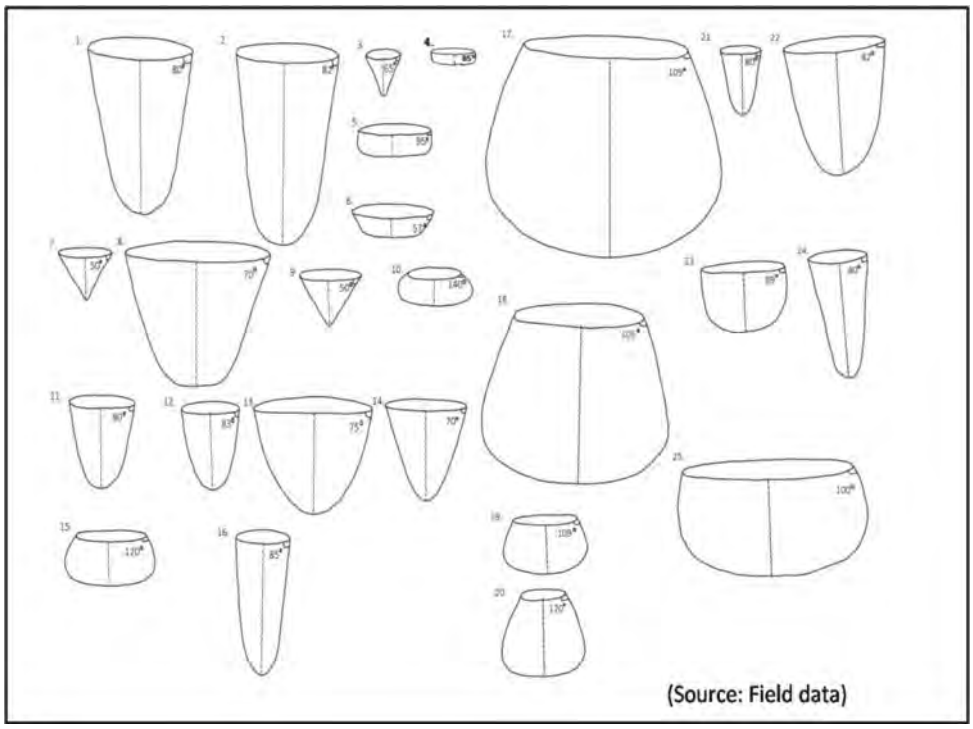

Fig.4. Sketch of twenty five potholes based on measured depth, diameter and angle of potholes

the river and makes circular depressions in the bed rocks over which the river is flowing (Kanhaiya & et.al.,2019)

Elongated potholes: Elongated potholes are the most common type of the potholes in the study area. It can be classified as more elongate and less elongated. About 68%(2013) and 56%(2019) of the total samples are elongated (including less & more elongated) types of pothole (table.1) These types of potholes show orientation of long axis either along the flow direction of the river or parallel to the veins or joints over the riverbed. These types of potholes generally indicate the higher flow regime and low eddy (Kanhaiya & et.al. 2019).

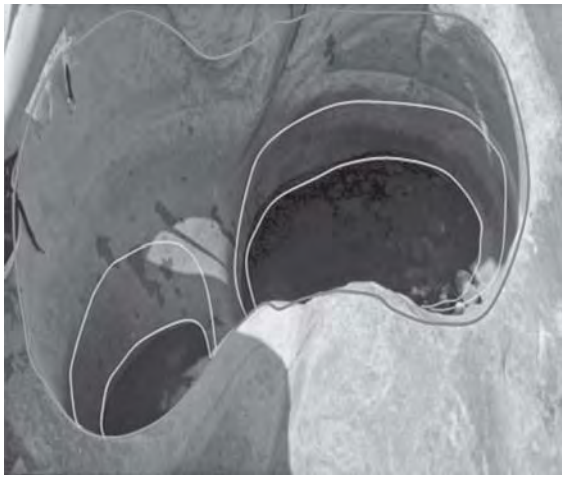

Plate. 2: *Integration of potholes (source: field survey, 2019)*

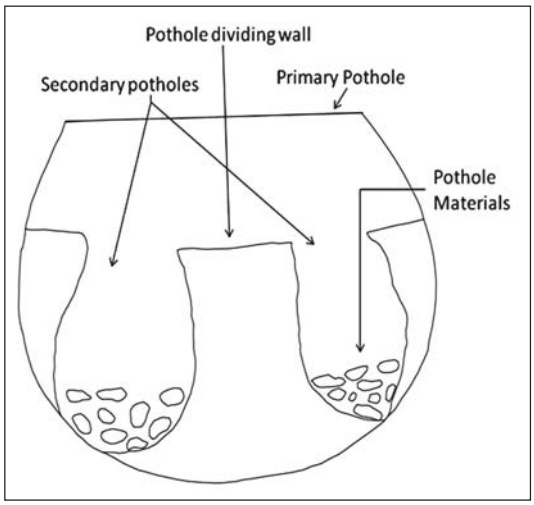

Fig:5: Rough Sketch of Potholes in Pot hole indicating primary and secondary potholes and potholes dividing walls. Source; Prepared by authors depending on field evidences.

The concentric pothole: Kanhaiya and others (2019) have stated concentric pothole in their research work. The present authors think that *concentric potholes* are nothing but the same form of *potholes in pothole* which is an excellent micro geomorphic expression of repeated rejuvenation in Subarnarekha river bed as well as basin. These potholes having 8% (table.1) of total samples (2019).Two potholes (Sl.no.13&17) have been identified as potholes in pothole during field survey (fig-4).

The concentric pothole or potholes in pothole is often associated with the giant quartz veins of the bed rocks (channel outcrop) of the river Subarnarekha at the confluence of Lokjeria and Subarnarekha. The present authors think that the development of concentric type pothole or potholes in pothole may be influenced by another way. That is *pothole integration mechanism.*

Development of potholes in pothole by *pothole integration mechanism*: Episodically, entrained stones entrapped in potholes erosion and abrasion floors and wall of potholes years after years to increase the depth and diameter of potholes. In this condition two adjoining pothole dividing wall(fig-5)becomes thinner due to both side erosion of pothole wall and gradually the potholes dividing upper wall is washed away and integration of upper part of potholes occur but at the lower part of the pothole, two different potholes are prominently observed(fig-5) and this forms potholes in pothole. Sometimes differential rate of erosion of two or several adjoining potholes dividing wall are observed, that influences the facial shapes of lower potholes. In the present photograph (plate.2) it is observed that right side pothole is elongated shaped and left side pothole is smaller and circular shaped. That indicates pothole dividing wall is maximum eroded towards right Side.Out of twenty-five potholes, in two potholes have been identified as pothole in potholes. Faster and irregular widening of pothole chamber and frequent coalescence of adjoining pothole give rise to higher degree of variation in radius of potholes (Das, 2019).

Irregular shaped potholes: These types of potholes having no regular geometric shape .Irregularities are observed along their edge of the potholes. Some scientists (Bera & others, 2019) have mentioned multidirectional growth of pothole. The authors think that irregular type of potholes are as like as pothole with multidirectional growth. About 20% (2019) of the total samples are irregular type of pothole (table.1).

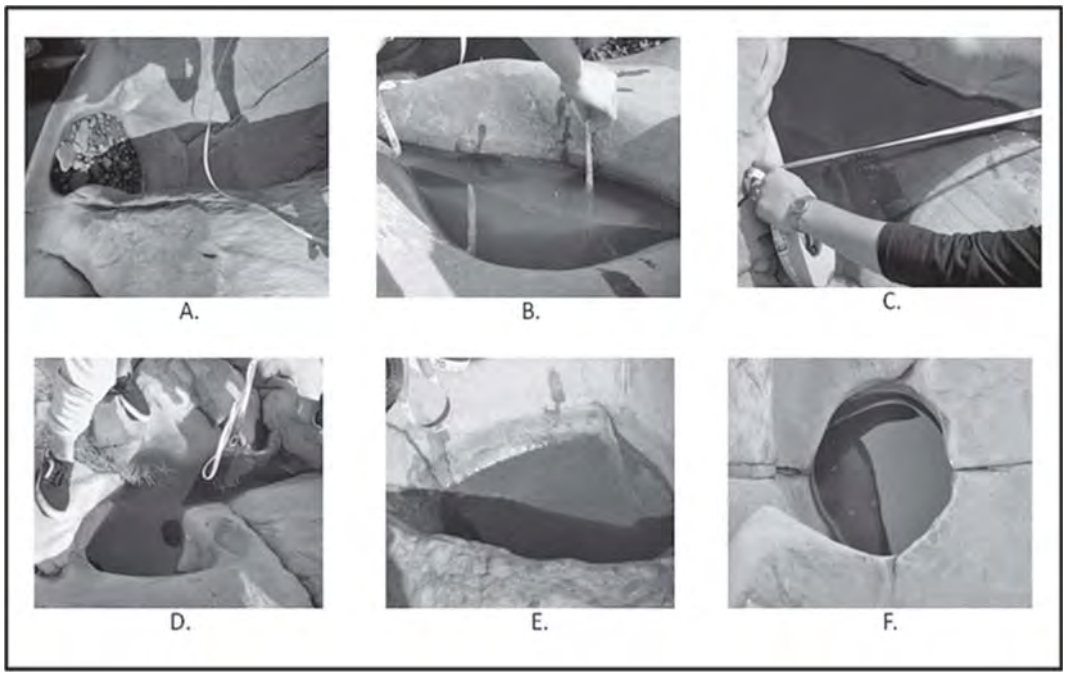

Plate.3 : Different shapes of potholes: A. semi circular, B.elongated, C.triangular shaped pothole, D.irregular shaped pothole indicates integration with adjoining pothole E.elongated pothole shows orientation of long axis parallel to the veins or joints over the river bed. F. circular shaped potholes influenced with joints of rocks. *(Source: Field Survey, 2019)*

In this case lateral expansion or growth of pothole is observed towards different directions influenced by joints or cracks of bed rocks.

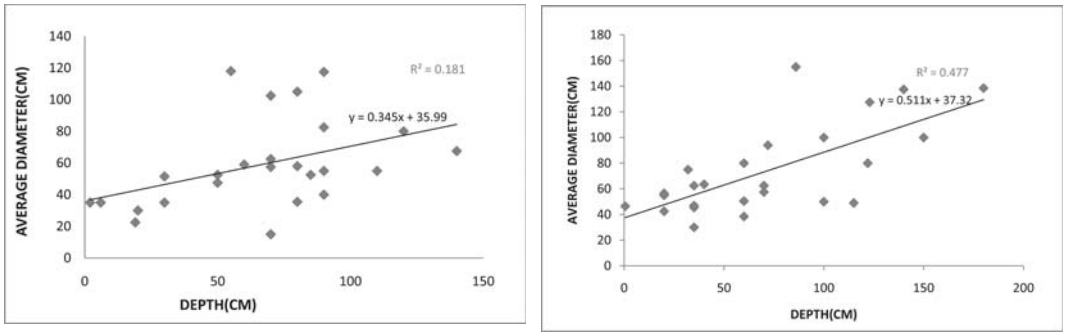

Fig: 6 : Scatter diagram at left side(2013) indicates positive relationship between depth and average diameter of potholes. Scatter diagram at right side (2019) indicates comparatively stronger positive relationship between depth and average diameter of potholes. *(Source: Field survey; 2013 &2019.)*

With the analysis of change detection data (2013 & 2019) it is found that mean value of major and minor diameter has increased from 2013 to 2019(table.-2). It proves that the development of potholes is influenced under active fluvial erosion. In 2013 mean major and minor diameter were 75.4cm. and 42.36cm. In 2019 mean values of both diameters have increased to 87.2cm. and 61.16cm respectively.

The mean value of approx annual erosional rate of major and minor diameter is 1.8964 cm/year and 3.1292 cm/year respectively (table.2). So, the mean value of annual erosional rate of minor diameter is greater (3.1292cm/y) than annual erosional rate of major diameter (1.8964cm/y). That reveals width (minor diameter) of the potholes is growing at faster rate compare to their length (major diameter). Depending on the calculated value it may be said that elongated potholes are converted gradually into oval and circular shaped potholes. Both of approx annual major diameter erosional rate(CV: 489.896) and minor diameter erosional rate(CV: 489.897) are about equally consistent .

In 2013 mean depth with pothole materials (with sediment materials) was 66 cm. and in 2019 the value increases up to 71.2cm (table.1) .This depicts that potholes are important components of channel incision. Progressively with the increasing of depth of potholes, valley deepening takes place to maintain the channel equilibrium in the river Subarnarekha. It is observed that depth(with grinding tools) of about 56 % potholes have decreased from 2013 to 2019.It means volume of grinding tools are increasing by years in terms of size and quantity. The scatter diagram(fig.6) of 2013&2019 also expresses that with the deepening of the potholes the average diameter is increasing. The positive relationship between two variables becomes stronger from 2013($R^2 = 0.181$) to 2019 ($R^2 = 0.477$) .

Conclusion

From the above discussion the authors have come to some conclusions regarding pothole development at the confluence of Subarnarekha and its tributary Lokjeria river near Rajbari, Ghatshila .These are like;

Potholes are micro fluvial geomorphic features, observed over hard rock of channel outcrop which expresses rejuvenation of the drainage system in recent time. These are undoubtedly the sites of high energy expenditure. The energy is utilized to erode the bedrock and occurrence of the micro features under the influence of dominant eddy in channel flow.

The statistical analysis (mean of annual erosional rate of major and minor diameter) reveals that in the study area width (minor diameter) of the potholes are growing at faster rate compare to their length (major diameter). Depending on the calculated value it may be said that elongated potholes are converted gradually into oval and circular shaped pothole.

Integration of adjoining potholes plays an important role to develop facial shapes of potholes as well as the nature of channel bed of river. Differential rate of erosion of two or several adjoining

potholes dividing wall influences development of potholes in pothole.

The scatter diagram of 2013& 2019 also expresses the positive relationship between depth and the average diameter of pothole. The positive relationship between two variables becomes stronger from 2013 to 2019. That indicates with time, both deepening and widening mechanism are accelerated altering shape of potholes . As a result, valley deepening takes place and equilibrium of channel gradient is maintained along the longitudinal profile of the river.

Within the last six years, shape of thirteen potholes (52%) have been prominently changed. In most cases more elongated or elongated shape of potholes have been altered into less elongated or other shape(Irregular, approximately circular, circular etc)of pothole. About 68% (2013) and 56% (2019) of the total samples are elongated (including less & more elongated) types of pothole and percentage of circular (including approximately circular) type of potholes have been identified in 2013 and 2019 are respectively 16% and 20%. In the year of 2013 irregular type of potholes were not found but in 2019 about 20% irregular type of potholes of the total samples have been noticed .

So, the above quantitative analysis proves a dynamic nature of pothole development in terms of different geometrical parameters (major diameter, minor diameter, depth of pothole, shape etc.) of the study area.

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Estimation of Shortwave Surface Albedo (SSA) and Its Impact on Thermal Environment in Kolkata

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Abstract : *Shortwave Surface Albedo (SSA) is an important controlling factor of the earth surface energy budget. SSA gives a clear indication about reflectivity of incoming solar radiation incident on earth surface. Quantification of SSA in urban environment is an essential task to delineate those urban surfaces which are less absorptive of solar energy to reduce surface level temperature. In this paper SSA was calculated using optical remote sensing data captured by Landsat TM sensor for April 2010 and November 2010 in the Kolkata Municipal Corporation (KMC) area in order to analyze summer and winter time spatial distribution of surface albedo. Land Surface Temperature (LST) was also estimated in KMC area by thermal remote sensing technique using Landsat TM thermal infrared data for the same years to correlate with SSA. The SSA was obtained on different urban surface elements and the results demonstrate that Surface Albedo was a leading factor of thermal environment in Kolkata.*

Keywords : *Shortwave Surface Albedo, LST, Landsat TM, Thermal Environment*

Introduction

Urban thermal environment is largely determined by reflective and emissive capacity of urban surfaces (Bhattacharya et al. 2009). Surface albedo and land surface temperature are two fundamental indicators to evaluate the thermal behavior of urban surfaces (Hamoodi et al. 2017). The surface albedo is defined as hemispherically and wavelength-integrated reflectivity of a surface and can be expressed as the ratio of reflected to incident radiation at a particular surface or combination of surfaces (Taha et al. 1988 and Taha 1997). Urban surface albedo indicates the reflectivity of different urban surfaces whereas land surface temperature elucidates the thermal properties and emissive capacity of earth surface (Becker & Li 1990). Urban surface albedo and land surface temperature can be estimated through remote sensing data in 0.3 to 2.5 μm and 7.0 to 20 μm spectral regions respectively (Despini et al. 2016). Optical remote sensing is the only means for spatial mapping of surface albedo (Liang 2000). Optical remote sensing includes the detection of solar radiation reflected from the earth surface through visible, near infrared and short-wave infrared bands. Several Landsat sensors like TM, ETM+ and OLI are capable to measure the ground surface reflectivity with optical bands. Liang (2000) developed an algorithm to estimate shortwave surface albedo combining all the

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optical bands except green band of Landsat TM and ETM+ sensors. Land surface temperature is an indirect measurement of thermal energy or surface heat of an object on land surface as a function of radiance measured by a thermal remote sensor using thermal infrared region of electromagnetic spectrum (Weng 2009).

To investigate urban thermal environment many scholars have assessed the relationship between surface albedo and land surface temperature. Menon et al. (2010) found out that land surface temperature decreased by 0.008 K for an average increase of 0.003 in surface albedo. According to Taha (1997) reasonable increasing of urban surface albedo contributed to a decrease of 2°C to 4°C air temperature in different cities in U.S.A. Hamoodi et al. (2017) showed an inverse trend between surface albedo and land surface temperature in Perth, Australia. Wang et al. (1995) observed that surface temperature linearly increased as surface albedo increased when surface albedo was low (0.1–0.2), and then linearly decreased when surface albedo was high (0.2–0.35). The positive slope at low albedo corresponds to vegetated and wet surfaces with high evaporation, while the negative slope at higher albedo corresponds to dry surfaces with extreme low evaporation. Studies of Menenti et al. (1989) in Egypt, Zhang et al. (2005) in Yellow River Delta, China, and Li and Xiao (2007) in the NW Tibetan Plateau showed similar relations.

The major objectives of the present study is to estimation of short wave surface albedo (SSA) and land surface temperature (LST) in order to investigate the thermal environment in Kolkata.

Study Area

The Kolkata Municipal Corporation (KMC) area was selected for the study. Kolkata, a tropical metropolitan city and the capital of West Bengal, is situated on the left bank of the Hugli River. KMC area extended from 88.24°E to 88.46°E and 22.43°N to 22.63°N and comprises with 144 wards covering 200.71 km^2 areas at an average elevation of 9 meters and located 154 km upstream from Bay of Bengal. Kolkata, most important urban habitat in eastern India, is characterized by unplanned urban growth leading to increase of impervious surfaces which absorbing more solar radiation and make the city vulnerable to heat stress. So for the study of SSA and its consequences on urban thermal environment, KMC area was chosen.

Kolkata, the “City of Joy” is basically belongs to tropical wet and dry climate with an annual mean temperature of 26.8°C and monthly mean temperatures in the range of 19°C to 30°C. The summer season extending from March to May receive maximum solar radiation and sometime temperature exceed 40°C. The city receives most of its rainfall from the South-West Monsoon between June to September and the annual rainfall is about 1,600 mm. The area experiences cold and dry condition from November to February with the monthly average temperature in the range of 9°C to 11°C. According to 2001 census 4580544 peoples were residing in KMC area.

1. Data and Methods:

3.1 Data Description:

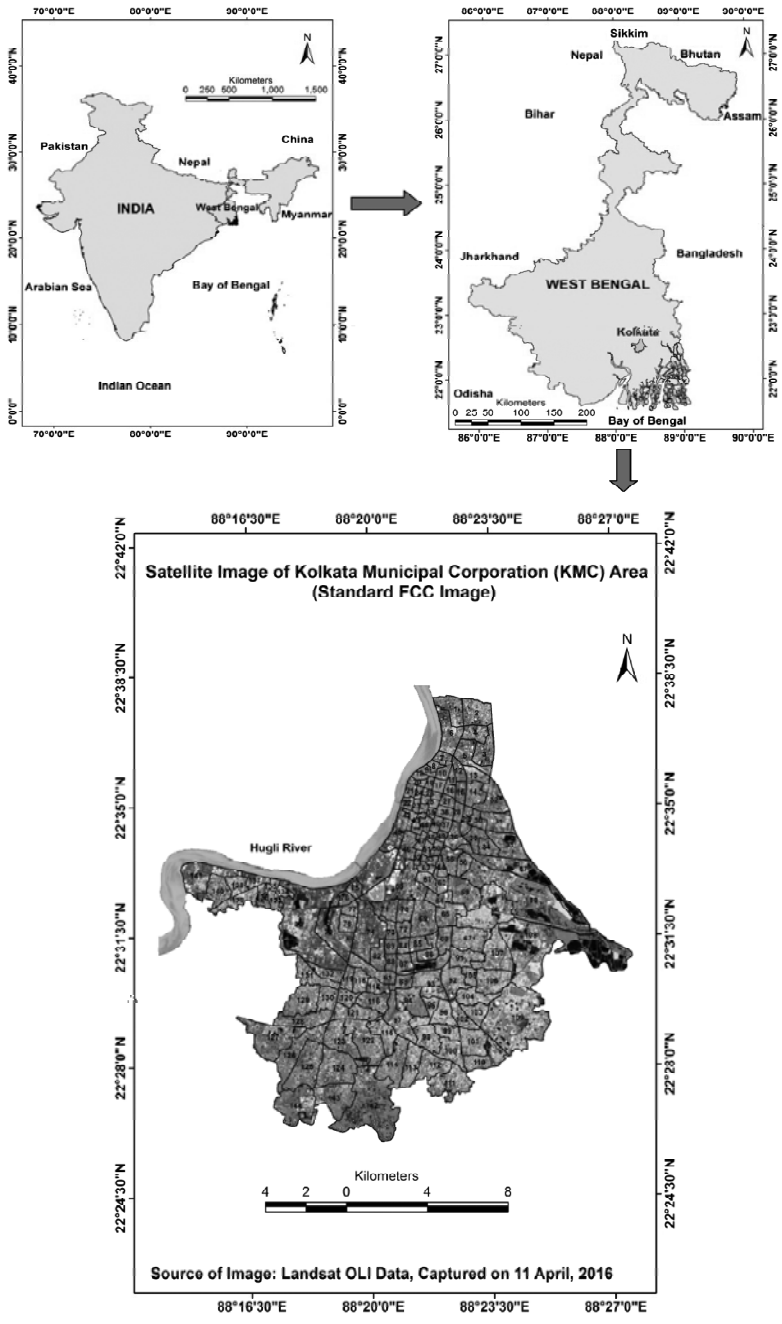

Fig 1: Location of Study Area

The work was totally based on satellite remote sensing data. Landsat TM images which were freely downloaded from the archive of United States Geological Survey (USGS). All the images were almost cloud free and clear. The details of the used images are-

Table 1: Summary of Landsat TM data used in this study

Scene Id	Sensor	Date of Acquisition (DD-MM-YYYY)	Path & Row	Used Bands	Spatial Resolution (m)
LT51380442010101KHC00	T M	11/04/2010	138 & 044	SWIR,NIR, RED,BLUE & TIR	Reflective Bands-30 m Thermal Band- 120 m
LT51380442010309BKT00	T M	05/11/2010	138 & 044	SWIR,NIR, RED,BLUE & TIR	Reflective Bands- 30 m Thermal Band- 120 m

Image Pre-processing

Atmospheric and Radiometric calibrations of the Landsat TM images were done using the image-based dark-object subtraction (DOS) method. Both images were geometrically rectified (Projection: UTM-45N, Datum & Ellipsoid: WGS 1984) and cubic convolution (CC) re-sampling technique was used. The root mean square (RMSE) error was less than 1 pixel and spatial resolution (pixel size) of all the bands, including the thermal band was 30 meter after resampling.

Shortwave Surface Albedo (SSA) Estimation

Liang (2000) developed an algorithm to calculate shortwave surface albedo from Landsat TM data. The equation of SSA estimation is

$$\alpha = \frac{\left((0.356 * \rho 1) + (0.130 * \rho 3) + (0.373 * \rho 4) + (0.085 * \rho 5) + (0.072 * \rho 7) - 0.018\right)}{1.016}$$

Where, α = shortwave surface albedo (SSA), ρ^i = top of atmosphere (TOA) reflectance value of Blue, Red, NIR, SWIR-1, SWIR-2 bands of Landsat TM sensor. SSA is the average reflectance of earth surface measured using shortwave bands of Sun's spectrum excluding Green band and values ranging from 0 to 1 (Liang 2000). Here, Landsat TM data was used for April 2010 and November 2010 in the Kolkata Municipal Corporation (KMC) area applying the above formula to analyze summer and winter time spatial distribution of SSA.

Land Surface Temperature (LST) Retrieval

Mono-Window algorithm (Qin, Karnielli, and Berliner 2001), Single-Channel algorithm (Jimenez and Sobrino 2003) have been developed to estimate land surface temperature from satellite remote

sensing data. But in urban climate and environmental studies relative LST estimation is required and hence, both algorithms are not widely applied in such cases (Weng 2009 & Meng and Liu 2013). According to Weng (2009), the majority of urban studies are interested in relative LST measurements, i.e., in mapping the spatial variations of LST and environmental modeling with relative LSTs.

In the present study, Landsat TM thermal infrared data (Band-6) was used to retrieve LST for April 2010 and November 2010 in KMC area by four different steps.

Firstly, digital number (DN) values were converted to top of atmosphere (TOA) spectral radiance using the following equation (Landsat Project Science Office, 2002):

$$L_\lambda = ((LMAX_\lambda - LMIN_\lambda) / (QCAL_{MAX} - QCAL_{MIN})) \times (QCAL - QCAL_{MIN}) + LMIN_\lambda$$

Where, $L_{\ddot{e}}$= TOA spectral radiance (watts/sq.m/steradian/micrometer), QCAL= The calibrated and quantized scaled radiance in units of digital numbers, $LMIN_\lambda$= Spectral radiance scales to $QCAL_{MIN}$, $LMAX_\lambda$= Spectral radiance scales to $QCAL_{MAX}$, $QCAL_{MIN}$= The minimum quantized calibrated pixel value (typically=1), $QCAL_{MAX}$= The maximum quantized calibrated pixel value (typically=255).

Secondly, the spectral radiance was converted to at-satellite brightness temperature as per the following formula (Landsat Project Science Office, 2002):

$$T_B = \frac{K_2}{\ln\left(\frac{K_1}{L_\lambda} + 1\right)}$$

Where, T_B= At-satellite brightness temperature in Kelvin, $L_{\ddot{e}}$= TOA spectral radiance (watts/steradian/sq.m), K_1 and K_2 are pre-launch calibration constants. For Landsat TM, the values of K_1 and K_2 are (Chander & Markham 2003):

Constant	Landsat 4 (TM)	Landsat 5 (TM)
K_1 (mW cm^{-2} sr^{-1} μm^{-1})	671.62	607.76
K_2 (Kelvin)	1284.30	1260.56

Thirdly, LST was derived from brightness temperature after spectral emissivity correction using the following equation (Artis & Carnahan, 1982):

$$LST = \frac{T_B}{1 + \left(\lambda \times \frac{T_B}{\rho}\right) \ln(\varepsilon)}$$

Where, LST= Land Surface Temperature in Kelvin, T_B= At-satellite brightness temperature in Kelvin, λ = wavelength of emitted radiance which is 11.45μm for thermal band of Landsat TM (Markham & Barker, 1985), $\rho = h \times c/\sigma$ (1.438×10^{-2} m K), σ = Boltzmann constant (1.38×10^{-23} J/K), h = Planck's constant (6.626×10^{-34} J s), c = velocity of light (2.998×10^{8} m/s) and ε = Surface emissivity.

Lastly, LST computation from Kelvin to Degree Celsius was done by subtracting 273.15 Kelvin from previously derived LST in Kelvin unit based on the relation of $0^{o}C = 273.15$ Kelvin.

Results and Discussion

SSA Distribution

Shortwave surface albedo in Kolkata for April 2010 and November 2010 was computed. In case of 11 April 2010 the range of SSA was 0.07 to 0.27 whereas in 5 November 2010 the range was 0.05 to 0.24.

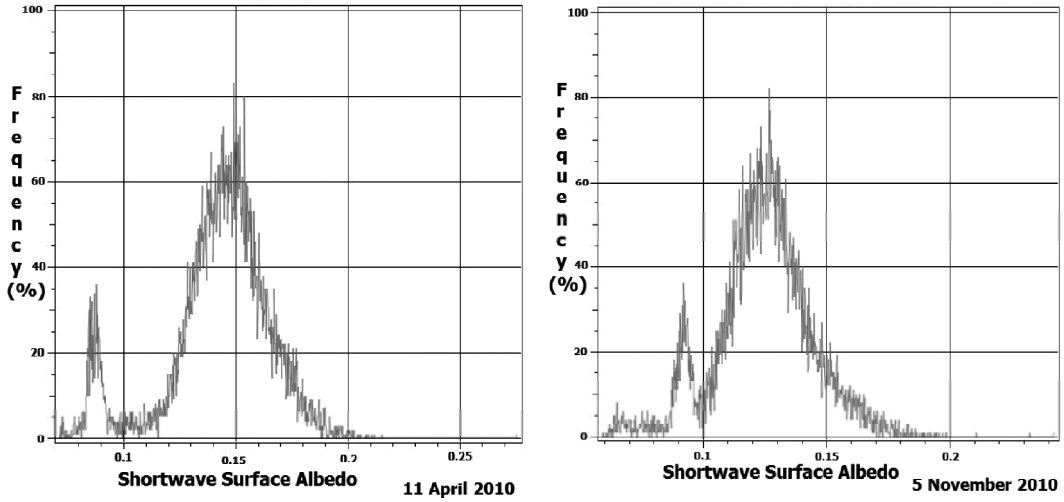

Fig 2: Distribution of Shortwave Surface Albedo

Due to higher insolation during April the SSA was relatively high in comparison with November. The nature of SSA distribution in Kolkata for both April and November months was bi-modal (shown in Fig 2) and mean SSA was 0.14 and 0.12 respectively. Two types of distribution were found. First 0.08 to 0.1 centric which indicating high density built-up surface with lack of vegetation and another was 0.12 to 0.14 centric distribution denoting high density built-up surfaces with moderate to low density vegetation. Outlier values were representing water and dense vegetation surfaces for both summer and winter seasons at Kolkata in 2010.

Spatial distribution of SSA at KMC area in summer (11 April 2010) and winter (5 November 2010) seasons have been shown in Figure 3 where North and Central Kolkata were depicting very

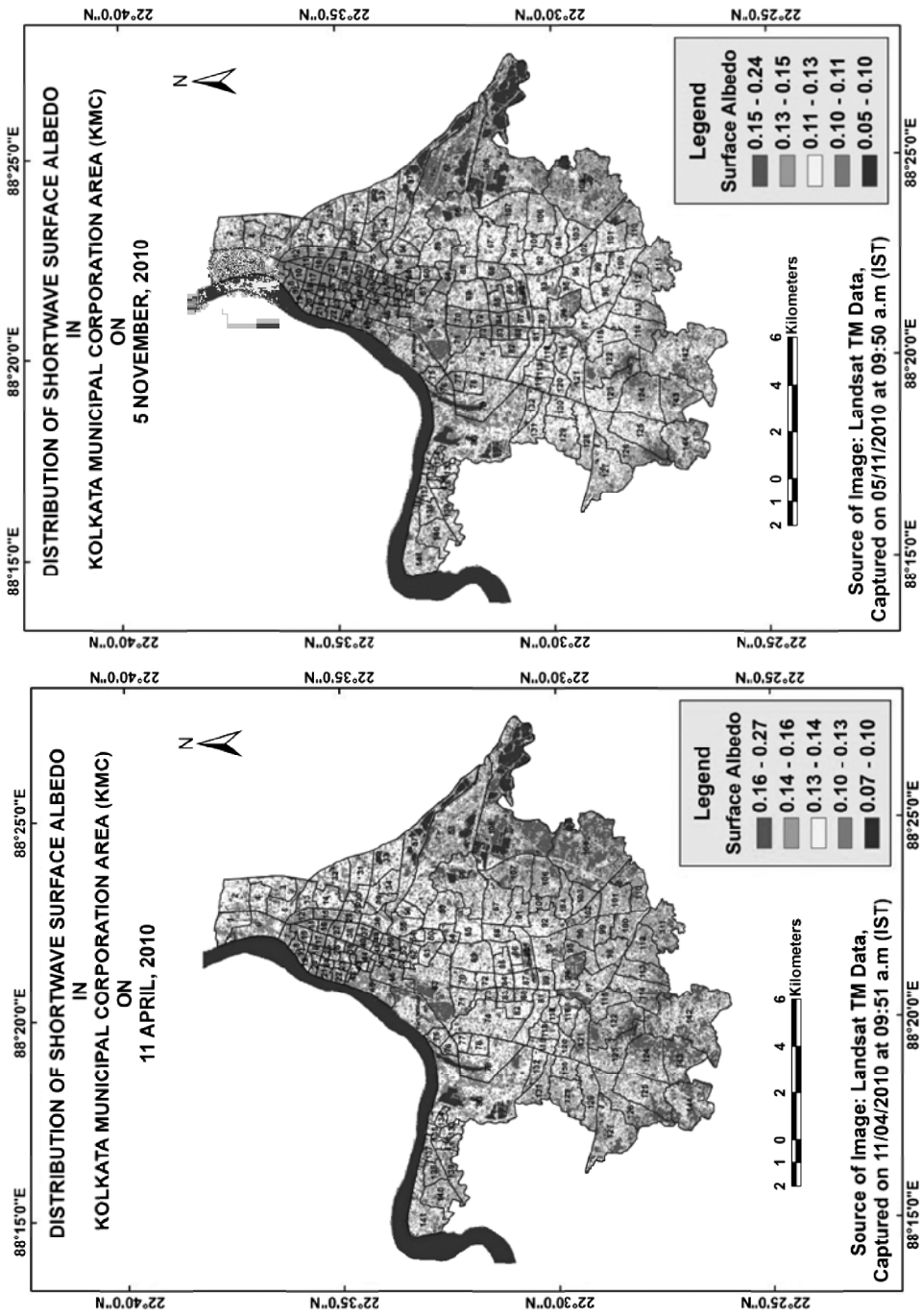

Fig 3: Spatial distribution of SSA

low SSA regions whereas South and South-Eastern Kolkata were high SSA areas. Summer time surface albedo was higher (0.2 to 0.3) than winter time. The ward wise distribution of SSA in KMC area has shown in Table 2.

Table 2: The ward wise distribution of SSA

SSA Zones	Mean SSA	Ward No.
High Albedo Region	0.15 - 0.20	58, 66, 67, 69, 94, 97, 101, 102, 103, 104, 106, 107, 109, 110, 111, 112, 113, 114, 116, 122, 123, 124, 125, 126, 127, 128, 129, 140, 141, 143, 144
Moderate Albedo Region	0.12 - 0.15	1, 2, 3, 4, 5, 6, 13, 14, 29, 30, 31, 32, 33, 34, 36, 56, 59, 63, 65, 74, 75, 78, 81, 82, 86, 87, 89, 90, 91, 92, 93, 95, 96, 98, 99, 100, 105, 108, 115, 117, 118,119,120,121, 130, 131, 132,133,138, 139, 142
Low Albedo Region	0.8 - 0.12	7, 8, 9, 10, 11, 12, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 35, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 57, 60, 61, 62, 64, 68, 70, 71, 72, 73, 76, 77,79, 80, 83,84, 85, 88, 134, 135, 136, 137

Source: Computed by the authors.

Urban Thermal Environment

Shortwave surface albedo plays an important role in determining the thermal behavior of urban surface materials. Thus, combinedly SSA and LST of any surface material would give a clear sign of urban thermal environment. In KMC area the spatial pattern of diurnal LST inversely proportional with SSA. For example North, Central and South-West Kolkata were depicting low albedo region due to high ability to absorb solar radiation for which LST was utmost and Southern peripheral region was showing the inverse scenario. In Figure 4 the spatial distribution of LST for the summer (11 April 2010) and winter (5 November 2010) seasons have been shown where, the range of LST was 31.25°C to 43.58°C on 11 April 2010 and 26.43°C to 37.55°C on 5 November 2010.

In this study, several urban land use and land cover categories and different surface material were identified and SSA and LST on those surfaces were measured. The estimated SSA and LST have been shown in Table 3 and 4. Green vegetation was mostly reflective surface and coolest surface in Kolkata. The mean SSA on Tree and Grass was 0.16 and 0.18 respectively in 11 April 2010 and was 0.15 and 0.16 respectively in 5 November 2010. Black Asphalt was the mostly absorptive or less reflective surface in KMC area. The mean SSA on black asphalt was 0.11 in summer and 0.09 in

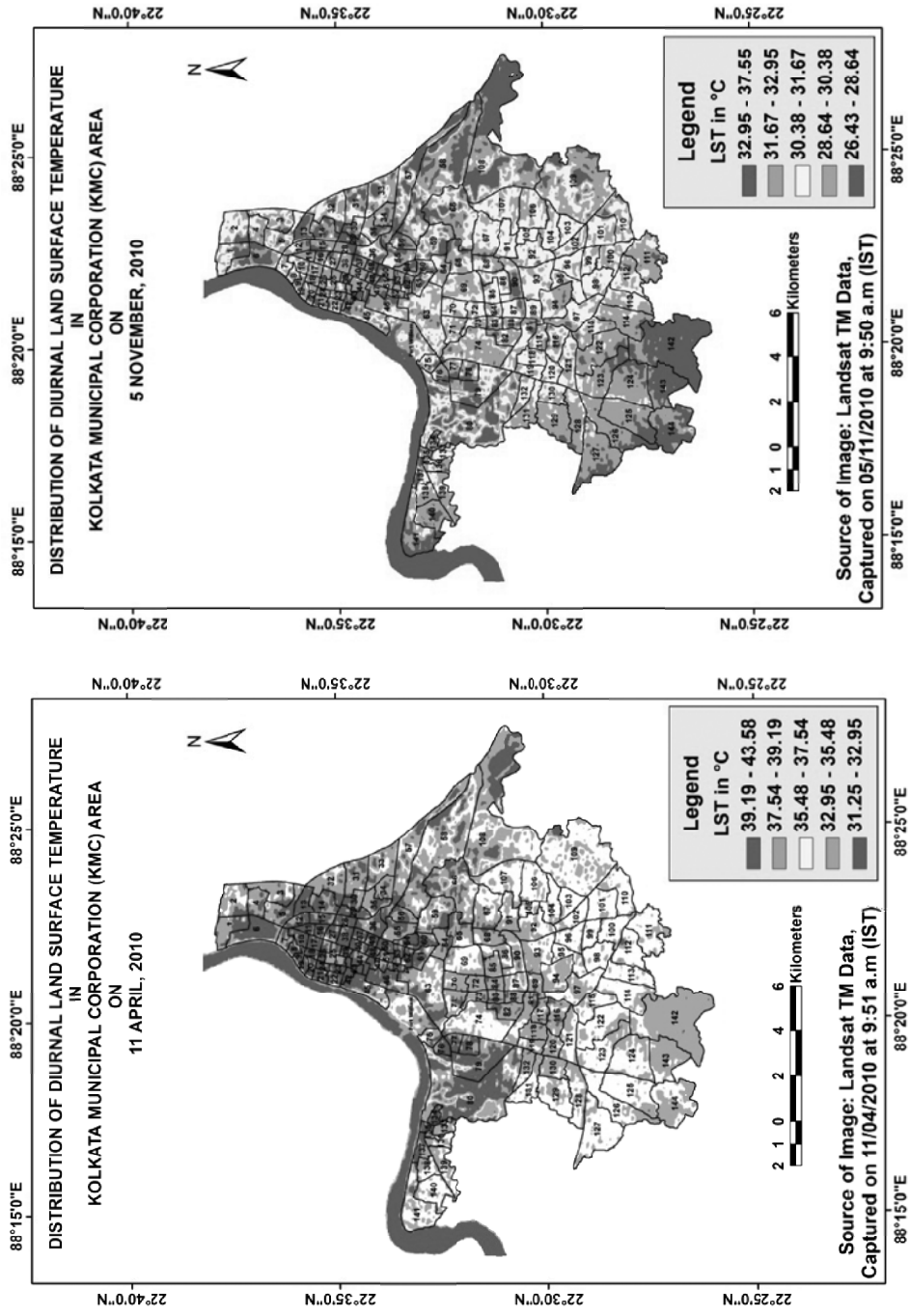

Fig 4: Spatial distribution of LST

Table 3: SSA & LST measurements at 9:51 am on 11 April 2010

LULC/ Materials	Sample	Geographic Coordinate	SSA		Diurnal LST (°C)	
			Absolute	Mean	Absolute	Mean
Black Asphalt	1	88.373451°E & 22.601692°N	0.11261	0.112779	40.401398	39.185
	2	88.362679°E & 22.586224°N	0.11315		38.781403	
	3	88.345776°E & 22.517028°N	0.112576		38.373535	
Grass	1	88.358632°E & 22.492391°N	0.175335	0.180219	35.067505	36.723
	2	88.341865°E & 22.544143°N	0.173839		36.730255	
	3	88.342262°E & 22.562012°N	0.191483		38.373535	
Tree	1	88.340820°E & 22.560807°N	0.154523	0.16465	38.373535	36.723
	2	88.354381°E & 22.492518°N	0.165772		35.067505	
	3	88.292139°E & 22.473359°N	0.173656		36.730255	
Water	1	88.400593°E & 22.568378°N	0.076027	0.076107	31.680756	33.644
	2	88.300450°E & 22.543273°N	0.070903		32.108765	
	3	88.369464°E & 22.627138°N	0.08139		37.142853	
Red Tile	1	88.374524°E & 22.542095°N	0.134794	0.1362	39.998108	40.266
	2	88.385597°E & 22.579246°N	0.138855		40.401398	
	3	88.378790°E & 22.575895°N	0.134951		40.401398	
Bare Soil	1	88.402679°E & 22.565164°N	0.215406	0.179649	37.964508	39.720
	2	88.347121°E & 22.557333°N	0.197986		39.593719	
	3	88.362884°E & 22.580310°N	0.125554		41.604645	
Concrete	1	88.361292°E & 22.571553°N	0.13291	0.13359	39.18811	39.322
	2	88.361648°E & 22.588967°N	0.132848		39.998108	
	3	88.367142°E & 22.518882°N	0.135013		38.781403	
White Metal	1	88.375963°E & 22.623517°N	0.17023	0.156963	39.998108	39.998
	2	88.295170°E & 22.541704°N	0.140671		39.998108	
	3	88.397474°E & 22.573127°N	0.159989		39.998108	
Old and Rusted Metal	1	88.276164°E & 22.551862°N	0.131687	0.122706	43.588409	41.597
	2	88.369397°E & 22.622575°N	0.099971		40.803589	
	3	88.375395°E & 22.532662°N	0.13646		40.401398	

winter. The concrete surface was also less reflective in nature. The estimated shortwave surface albedo on concrete was 0.13 and 0.11 in summer and winter respectively. Water was the highest absorptive and lowest reflective surface in Kolkata as the measured SSA was 0.07 and 0.06 in summer and winter correspondingly.

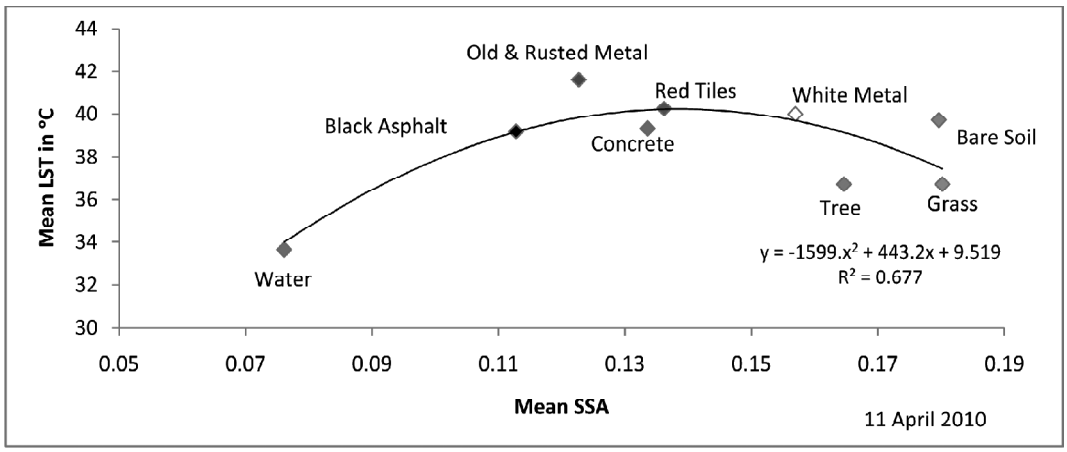

Fig 5: Relation between Mean SSA and Mean LST in summer

Relation between shortwave surface albedo and diurnal land surface temperature was not linear. Polynomial (order 2) regression model (Figure 5 and 7) was best fitted (R^2= 0.67 and 0.70) to show the relationship between SSA and diurnal LST. The correlation was inversely related to Grass, tree, bare soil and white metal whereas positively correlated to water, black asphalt, old & rusted metal, concrete and red tiles. Second order polynomial best fit curve (parabolic) was showing that LST was not controlled by SSA alone but there were several another factors determining the land surface temperature. Water surface hardly reflects solar energy but absorb with maximum extent, however water body had relatively low diurnal LST due to its high specific heat and high thermal inertia. Likewise concrete surface also had the same thermal behavior. Hence, thermal inertia was a key factor of diurnal thermal environment in Kolkata. Old & rusted metal and white metal had high reflectivity and high diurnal LST as well. It indicating metal sheets was very emissive material with very low thermal inertia. On the contrary green vegetation reflects solar radiation with highest magnitude but emits surface heat at lowest extent.

In Figure 6 mean SSA of different surface materials in KMC area has been shown and it is clear that all the man made materials like black asphalt, concrete and metal sheets had low SSA or high ability to absorb solar radiation but natural surface covers like tree, grass, soil etc had high potentiality to reflect solar radiation to make urban environment relatively cool and comfortable.

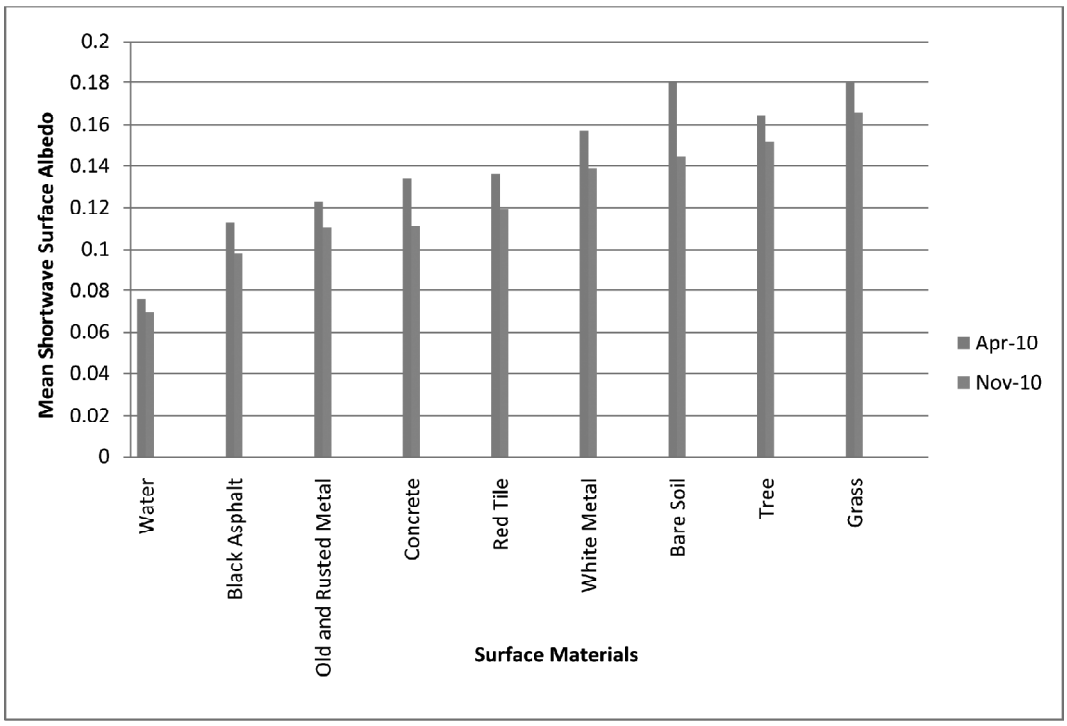

Fig 6: Surface materials specific SSA distribution

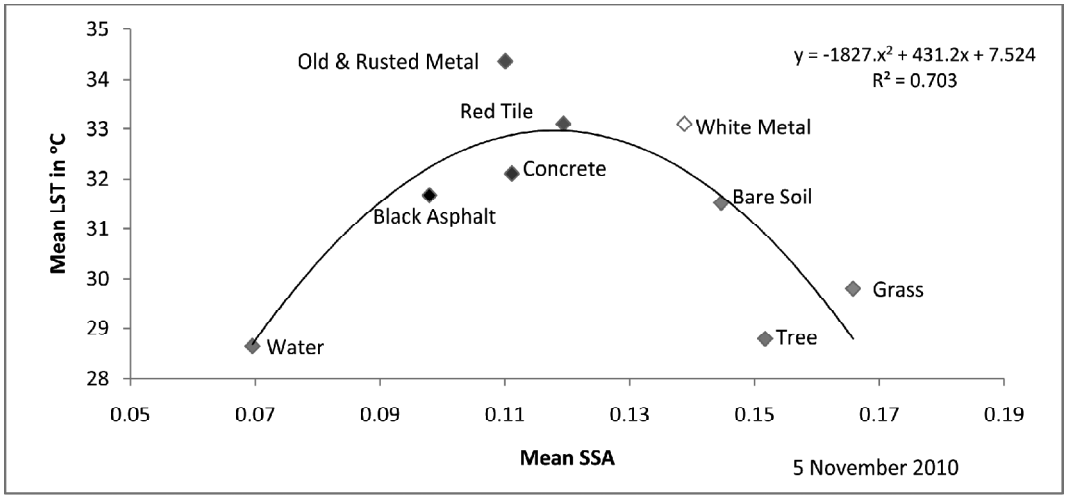

Fig 7: Relation between Mean SSA and Mean LST in winter.

Analyzing the impact of SSA on diurnal LST in Kolkata, it was observed that diurnal LST was linearly increased with increasing SSA when surface albedo was low (0.05 to 0.14) but diurnal LST was linearly decreased with increasing SSA when surface albedo was high (0.14 to 0.27).

Table 4: SSA & LST measurements at 9:50 am on 5 November 2010

LULC/ Materials	Sample	Geographic Coordinate	SSA		Diurnal LST (°C)	
			Absolute	Mean	Absolute	Mean
Black Asphalt	1	88.373451°E & 22.601692°N	0.105109	0.097895	31.680756	31.680
	2	88.362679°E & 22.586224°N	0.093641		31.680756	
	3	88.345776°E & 22.517028°N	0.094935		31.680756	
Grass	1	88.358632°E & 22.492391°N	0.155644	0.165803	29.955078	29.810
	2	88.341865°E & 22.544143°N	0.179313		29.520142	
	3	88.342262°E & 22.562012°N	0.162453		29.955078	
Tree	1	88.340820°E & 22.560807°N	0.159007	0.151698	28.645905	28.791
	2	88.354381°E & 22.492518°N	0.148818		28.645905	
	3	88.292139°E & 22.473359°N	0.147269		29.083801	
Water	1	88.400593°E & 22.568378°N	0.059138	0.069556	27.765869	28.642
	2	88.300450°E & 22.543273°N	0.073575		28.206665	
	3	88.369464°E & 22.627138°N	0.075956		29.955078	
Red Tile	1	88.374524°E & 22.542095°N	0.117831	0.119385	32.960663	33.101
	2	88.385597°E & 22.579246°N	0.123713		33.384613	
	3	88.378790°E & 22.575895°N	0.116612		32.960663	
Bare Soil	1	88.402679°E & 22.565164°N	0.166005	0.144653	30.388611	31.528
	2	88.347121°E & 22.557333°N	0.155498		30.388611	
	3	88.362884°E & 22.580310°N	0.112455		33.807312	
Concrete	1	88.361292°E & 22.571553°N	0.113506	0.111122	32.108765	32.108
	2	88.361648°E & 22.588967°N	0.111317		32.108765	
	3	88.367142°E & 22.518882°N	0.108544		32.108765	
White Metal	1	88.375963°E & 22.623517°N	0.161565	0.138756	34.228668	33.099
	2	88.295170°E & 22.541704°N	0.108446		32.5354	
	3	88.397474°E & 22.573127°N	0.146256		32.5354	
Old and Rusted Metal	1	88.276164°E & 22.551862°N	0.117853	0.11007	35.067505	34.366
	2	88.369397°E & 22.622575°N	0.086447		33.384613	
	3	88.375395°E & 22.532662°N	0.125911		34.648712	

Conclusions

This research paper highlights the estimation of shortwave surface albedo to assess the reflectivity of urban Kokata and to investigate the correlation between SSA and LST in order to understand the diurnal thermal environment in KMC area in summer and winter as well. Summer time surface albedo was relatively high (2%) than winter. Spatial distribution of SSA in both seasons indicates north, central and north-west Kolkata was high diurnal LST regions than rest of KMC area. Southern peripheral Kolkata was comparatively cooler (5°C to 7°C) zone in KMC area due to 6% to 8% high SSA than north and central Kolkata.

Surface elements or materials specific SSA and its corresponding LST values showed that green vegetation was the only surface which reflects most part of the incoming solar radiation and produce cold spots in Kolkata. Old and rusted metal sheets were high reflected as well as high emitted surfaces as it increased both the diurnal LST and SSA. Dark colored or black asphalt was one of the important road-constructional material had high thermal capacity to increase diurnal land surface temperature. Red tiles frequently found in slums had high diurnal LST values whereas concrete (built-up surface) was highly absorptive of solar radiation or least albedo surface (SSA was 11% to 13%) but exhibit relatively low diurnal LST indicated high thermal inertia. Likewise, Water also had very high thermal inertia as it absorb almost 93% of solar radiation incident on water bodies but created diurnal cold spots in Kolkata.

Finally, the correlation between SSA and LST was non linear and the result confirmed that on all kind of man made surfaces SSA and diurnal LST were positively correlated but on natural land cover or non built-up surfaces both parameters were negatively correlated. The study argued to preserve and enhance the green and water surfaces to reduce surface heat island effect in KMC area.

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Geomorphic Units of The Sikkim Himalaya

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Abstract : *The Sikkim Himalaya is a tiny but unique segment of the entire Himalayan system. The ridges and spurs lying in this segment mostly belong to the Great and Middle Himalayas with altitudes varying from two to eight thousand metres. The rugged mountains together with extremely dissected valleys of the tract exhibit their evolution through vigorous weathering and erosional processes in one hand. On the other hand faults and thrusts of different sizes along with cascades and terraces of different volumes (both of fluvial and glacial types) show structural instability of the region too. The neo-tectonic upliftments of the terrane have made the landscape much more attractive to the explorers as well as earth scientists. Hence the present paper is trying to attempt for identification of geomorphic units of the whole region (in a meso-level study) which must be a guide-base for the future researchers.*

Keywords : *Thrust, Terrane, Morpho-climatic region, Glaciofluvial, Periglacial, Massif, Shastrugi, Sichelwannen.*

Location and Area

Sikkim is located to the north of West Bengal and is bounded by Nepal, Tibet (China) and Bhutan in its other sides. Administratively the state is divided into four districts – North, West, South and East Sikkim. All the districts are totally adorned with picturesque mountains and their associated ridges. In no part is found a plain except the narrow strips of terraces along the deep glens. The boundaries of the state are well demarcated by natural elements: west, north and east running along the watershed of the great Tista basin; whereas the south following the courses of the rivers Rammam- Bari Rangit and Rangpo. The latitudinal extension of tract is 27p 012 to 28p 082 N, while its longitudinal confinement lies in between 88p 012 and 88p 552 E. Maximum length from north to south is 112 kilometre, while the same from west to east is only 84 kilometre. Total area of the region is 7096 square kilometre, though the surface area seems to be much larger on account of its wavy, extremely dissected topography netted with ridges and valleys of irregular shape and size. The highest point of the state is represented by the eastern part of North Kangchendzonga peak (8586m). The elevation rapidly decreases towards south-east and descends below 400 metre contour at Melli - the southernmost point of the terrain.

Objectives and Methodology

The present study is meant for exploring the structural background of the Sikkim Himalaya. The other objectives include finding out the regional contrast in Geomorphological features in the

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state; and to identify Geomorphic units of the tract on the bases of Litho-structural characteristics as well as Landform variation.

Since this is a first time effort to delineate the Geomorphic units of the Sikkim Himalaya in meso-level, hence the author had to depend mostly on field study for prolonged period (more than three decades). However, for acquiring basic ideas about the topography of the state topographical maps published by SOI and satellite imageries produced by ISRO have been examined in detail.

Structural Background

The beautiful landforms of the Sikkim Himalaya are resting upon such a geological structure which is one of the most complicated structures not only in the Himalayan Ranges but also in the world. In general the region comprises a series of thrusts the planes of which are inclined from north to south. The angle of the thrusts decreases also from north to south - more than 30p near Chomoyummo to less than 10p around Jorethang and Rangpo. The faults along the Tista valley divide the thrusted blocks into two main groups: in the west Jongsong- Kangchendzonga- Kabru- Singalila; and in the east Gurudongmar- Dongkiya – Chola Ranges. The blocks lying in the western part are more massive and elevated than those located in the eastern part.

The first map of geological characteristics of the Sikkim Himalaya, though in incomplete form, was prepared by W. S. Sherwill in 1854. In 1874, F. R. Mallet, a geologist of G. S. I., Published a coloured map of the region with his report on mineral resources which are found locally. In 1878, the Tista valley was traversed by L. V. Loczy who described in details the thrusts and other types of faults found in that segment. Following his account E. Suess, the Austrian expert on the Alpine structure, explained elaborately the nature of the strata in his famous book ‘Das Antlitz der Erde’ brought out during 1883-88.Here he first pointed out the ‘Nappe’ structure of the Singalila and Dongkiya Ranges. Advancement of the concept regarding Nappism of the Ranges lying in south-west and south-eastern sections of Sikkim as well as the high thrusting in the northern mountains went on by the explorers of the 20th century. F. Smythe and E. E. Shipton identified the fossiliferrous rock beds in the Jongsong peak during their expedition in 1930. The nature of thrusts enclosing the Great Himalaya extending from Kangchendzonga to Pauhunri was clearly described by S.S. Roy in early 1980’s. Recently, especially during the last three decades, many Indian geologists along with the scholars from different Universities studied the region in detailed. They unveiled almost all the complicacy in the structure of the mountains and valleys through their micro-level studies and explained them much more scientifically.

Although the width of the entire Himalayan mountain chain is the narrowest in Sikkim-Darjiling region the pair of Main Central Thrusts can clearly be identified here: the first one running along the southern precipices of Kabru- Simvo– Siniolchu- Gurudongmar mountains, and the second running below the straths of the rivers Rammam-Baro Rangit and Rangpo. The Ranges lying in between these two great thrusts may be grouped as the part of the Middle Himalaya. The Lesser Himalaya is exclusively located in the south of the southern Main Central Thrust and comprises the

ridges of Darjiling and Kalimpong districts, West Bengal. The Great Himalaya masters up the loftiest parts of the system and includes all the mountains lying to the north of the northern Main Central Thrust. Almost all portions of the Middle and Great Himalayas are composed either of Archaean gneiss and schists or of felsic igneous rocks originated in Upper Tertiary period except the extreme southern belt where some sedimentary facies, though very much squeezed and partly metamorphosed, seem to be exposed by prolonged denudation.

The Northern Boundary Fault marks the northern limit of the Great Himalaya. It continues from the Nepal gap in the west to Chholamu lake area in the north-east. Two main headstreams of the river Tista, the Lhonak chhu and Lachen chhu have set up their valleys along this Fault. The mountains lying beyond the Fault may be grouped into the Trans-Himalayan Range. Jongsong and Chomoyummo mountains are two important units of this system. They are composed of fossiliferous sedimentary rocks showing from Lower to Upper tertiary formations.

Evolution of Landforms

The evolution of landforms in the Sikkim Himalaya is controlled strongly by the local tectonic movements as well as past and present climatic conditions prevailing over the tract. Since the mountains are located on the colliding plate margin (Indian – Tibetan plates) and are rising rapidly (10 to 12 mm per year) they are very fragile in nature. Moreover the terrain is influenced heavily by the oscillating winds in different seasons. In fact the region experiences the chill effects of the North-Eastern Trade blowing from the Tibetan Highland from October to May, while it bears the moist attack of the South-West Monsoon from June to September. Total amount of precipitation caused by these two winds is much more than any other part of the Middle or Great Himalayas. Thus the denudation processes are also vigorous over the mountains. According to Strakhov's categorization of morpho-climatic region the land belongs to 'Ta' zone. Characteristically the tract is very much rugged and the landforms produced here are changing quickly. The variation in denudation processes and their intensities have been increased during the Holocene epoch, especially after the deglaciation of the Pleistocene ice sheets spread over the mountains. As a consequence the rates of slope retreat across the mountain faces and the valley deepening in between have enhanced enormously in the last few millenniums.

Until 4000 years before present the entire region was covered with the last phase of Pleistocene ice sheets showing little or no sculpturing over its landforms. The sheets began to retreat thereafter and, astonishingly with rapid pace, leaving some major and numerous minor glaciers. The latter ones retreated in the last millennium - the snouts of the major glaciers rose above 5000 metre in the eighteen century while the minor ice-flows became extinct. At present the summit sections of the lofty mountains situated above 6000 metre are only covered with permanent ice caps. Maximum portions of the terrain are now exposed either for glaciofluvial or fluvial processes. A little belt lying in between the Great and Trans Himalayas, especially along the upper sections of the Lhonak and Lachen chhu, show some effects of aeolian process. While the extreme south- eastern part, along the gentler slopes of the Chola Range, exhibits some accumulations of periglacial deposit.

Regional Contrast in Geomorphological Features

The geomorphology of the Sikkim Himalaya was observed and described part by part by many explorers in the 19th and 20th centuries. In 1848-49 J. D. Hooker, the famous naturalist, traversed large part of western and northern sectors and presented a vivid account of landform characteristics of the districts. J. C. White examined the local physiography in more detail through his journeys across the Ranges of the entire state during his prolonged service-period as the British Political agent in Sikkim (1887-1908). He is the first person who surveyed and marked the northern limit of the Tista basin. The magnificent landscapes of the massif Kangchendzonga and its surrounding mountains were further analysed by D. W. Freshfield during an expedition of an enthusiastic team led by him in 1899. His book 'Round Kangchenjunga', well illustrated with many maps and photographs, provides valuable information of the region regarding differentiated terrain as well as condition of glacial fields during that time. In 1950's M. K. Bandopadhyay, an eminent Indian geomorphologist observed the landforms of North Sikkim. He explained them first in the view of geomorphological science. In late 1970's S. C. Mukhopadhyay studied the Tista basin as a whole and published his research-works in an encyclopaedic book 'The Tista Basin'. Since 1980's many other Indian geomorphologists have been selecting different parts of the tract for their researches. Their theses elucidate more the alteration of physiographical constituents of the areas in relation to recent environmental changes. The local expedition-teams also give us valuable information on changing nature of the surface configuration lying in high altitudinal segments.

In respect of altitude, shape and size the landforms in the region show spectacular but perplexed figures sometimes varying within a very short distance. Like other parts of the Himalayan mountain system the chain of the Great Himalaya of this state rises high enough to its neighbouring ridges. The massif of Kangchendzonga peaks stands at its westernmost point but shares a heavy isostasy being deep rooted (about 80 km) with extensive base (over 100 sq. km) composed of compact granite-gneissic rocks. Sedimentary formation is found over 8000m with a negligible slice (250m) of yellow sandstone. Three out of five peaks, North (the highest, 8586m, as stated earlier), Central (8482m) and South (8494m) stand along the International boundary between Nepal and Sikkim. Other two, North-western peak, also known as Yalung Kang (8505m) and the most western one Kangbachen (7903m), are exclusively located in Nepal territory. The great North Kangchendzonga peak is saluted by a series of mountains each of which has a stupendous mass though seem to be humble in size on account of their nearby king. From close to distant location from the king running towards north the peaks of these mountains are Twin (7117m), Tent (7343m), Pyramid or Phatibara (7123m) and Lango (6920m). Some famous glaciers are found at their eastern face, e.g. Zemu at North and Central Khangchendzonga, Green lake glacier at Twin, and Lhonak at Lango. All of the glaciers have been retreating rapidly for the last two centuries.

From central part of Kangchendzonga stretches another line of Generals standing across a high jagged Range with varying width of 5 to 15 kilometres. They are relatively slender in size but much magnificent in shape. From west to east (slightly swinging north-easterly) they are Simvo (6812m), Siniolchu (6888m), Lama Anden (6116m), Kangchengyao (6889m), Gurudongmar (6715m)

and Pauhunri (7125m). All of them are ice-covered though the volume of their glaciers is less than that of the northern mountains. The Cervino-type peak Siniolchu represents the maximum gradient along its free-faces (more than 75p) and is said by the explorers 'The Gracest Mountain in the world'. After Lama Anden the Range has been shifted northward by a Transverse Fault through which passes the Lachen chhu. The stream is the main source of the mighty river Tista and is originated from the glacier Kang tse lying at northern face of Pauhunri. The valley of the stream is wide and shallow with very slender thalweg in its upper section situated over a thick moraine-belt, but becomes narrow and deep, rocky gorge just entering into the aforesaid Fault. From Kangchengyao a klippen type ridge, Tsen-gui Kang, extends southward for about 40km parallel to that Fault. Its altitude reaches maximum at the spire Chombu (6362m) and terminates abruptly at Chungthang (1790m) - the confluence point of the torrents Lachen chhu and Lachung chhu, and the starting point of the river Tista.

In front of the southern precipice of South Kangchendzonga peak a large brigade of mountains are standing from south-south- west to south- south-east. They are badly dissected by vigorous attacks of sub-aerial erosional activities. In Sikkimese territory the main guards are Talung (6529m), Kabru group (North peak-7338m), Rathong (6678m), Koktang (6147m) and Pandim (6691m). The glaciers lying at their bases are small in volume and flow down enough below the permanent snow-line (occasionally reaching 4200m). Except Talung, all of them lie at the head of the river Bari Rangit which is the main right hand tributary of the river Tista. There are many conjectures regarding its age and valley formation. According to recent geological explorations along with geomorphological observations it may be concluded that the river originated sometime in between the last two Pleistocene ice ages and initially was a sluggish subsequent stream of the river Rammam (west of Jorethang lies the confluence point of the two). The latter is much older in age (Oligocene), directed by the lineation of Main Central Thrust and was a larger tributary of the Tista in many interglacial times. The glaciers situated over the south-eastern slopes of Talung and South Kangchendzonga, however, follow a common easterly direction – another example of a structurally controlled valley but bedded over higher altitudes. Residuals of glacial terraces along the valley indicate the elevation of the former glacial valleys developed in different phases of the Pleistocene glaciation. The river Talung chhu carving this valley joins the Tista near Mongan, the headquarters of North Sikkim district. The water-parting between the Talung chhu and Bari Rangit is represented by a series of high ridges crowned with some lofty crags the altitudes of which vary from 5500 metre to 5800 metre. Narsing peak (5840m) is the highest amongst them revealing a mass resistant to erosion because of its pure gneissic structure.

The western side of the Bari Rangit basin is bounded by the Singalila Range – a spectacular nappe uprooted from the Kangchendzonga-Kabru mountains. It stretches from Kang peak (5580m) for about 40km and crosses the southern Main Central Thrust to the south of Melido or Singalila peak (3685m). Due to its fragile structure the summit line is very much undulating: the sharp rock pinnacles are projected at the end of synclinorium; while round headed crags are situated on its stable central portion. Sub-aerial erosion has obviously been increasing the ruggedness of crest-line since the retreat of Pleistocene ice-covers.

From Pauhunri emanates a large thrust, Dongkiya Range which strides southward for about 50 kilometre. It is separated from Tsen-gui kang by a fracturing belt of the Lachung chhu valley and leans over the Chola Range just north of Cho la (4435m). The altitude of this Range decreases from 6500 metre in the north to 4400 metre at its southern end. No permanent glacier is present along its central and southern parts, though huge amount of snowfall occurs during the prolonged cool period: from late September to June. Consequently glaciofluvial landforms such as proglacial channels with sandur valleys and kame terraces are very common in the region. The stream Rate chhu originates near Cho la which makes the boundary between North and East Sikkim, and ultimately plunges into the river Tista near Dikchu. The Range Chola extends further south for 20 kilometre along the eastern boundary of East Sikkim and acts as the water-divide between Rangpo-De chhu valleys lying in the district and Ammo chhu in Tibet. Nathu La (4310m) and Jelep La (4270m) are two famous passes across this Range. Rangpo with its numerous tributaries drains more than half of the East district and joins the Tista near Rangpo town - the main gateway of the state Sikkim. On the contrary, the De chhu excavates a narrow valley in south-eastern portion of the area, cuts deeply the last tip of Chola Range and ultimately flows southward through a glen to mark the boundary between Darjiling district and Bhutan. After meeting its left bank tributary, the Ne chhu, the river is renamed as Jaldhaka.

The mountains along the northern boundary of Sikkim and beyond Chorten Nyima La (5685m) belong to Trans Himalayan system. Jongsong (7462m) peak is the highest among them. All of them including the subdued ridges on the north of the upper Lachen valley are carved both by glacier and wind resulting round-headed, grooved and fragile landforms partly due to soft sedimentary structure but mostly by the effects of arctic to sub-arctic climates prevailed over the section. The permanent ice-cover (shastrugi-like icy coverage) over the upper Lhonak valley has diminished during the last hundred years. It is now characterised by different types of friction cracks and sichelwannens. Chomoyummo (6829m) is the second highest in the northern mountain belt whose projected mass Chuma kang ridge compels the Lhonak chhu to flow south-easterly direction before plunging down into the Lachen chhu (just north of Lachen town).

Regular tectonic disturbance as well as intensive glacial action causes numerous excavations in the surface topography of the state. Most of them represent enchanting lakes (more than tens of hectare in areas) – fed either by glacier or by rains. Gurudongmar (5200m) and Chholamu (5100m) are two such glacier-fed lakes lying at the head of the Lachen Chhu valley. Their depths are decreasing constantly by the depositional work of the southlying glaciers. Green lake (4600m), at the confluence of the snouts of Zemu and Green lake glacier, has been transformed recently into a boulder-strewn bog for the same reason. There are many tarns at the base of Chola Range amongst which Tsomgo (3800m) and Kupup (4000m) are frequently visited by the tourists. The first one is at the head of the Lungze Chhu and is in very distressed condition in effect of increasing anthropogenic activities. The second one, lying along the sagging part to the west of Jelep la, is the main source of the De chhu. The lake area, however, shows relatively better environs. Human construction is absent here till now most probably for its harsh climatic condition. A number of medium sized tarns are found in the upper portion of the Bari Rangit valley. These are located in different altitudes –

from 1700 metre to 5000 metre. Most of these are inaccessible to general tourists and, hence, are free from human interferences. All these lakes are going to be filled up slowly by natural processes of mass-wasting.

Geomorphic Units

Geomorphic Unit	Litho-stratigraphical characteristics	Landform variation
1. Summit section of the Great and Trans-Himalayas (above 6000m).	1. Gigantic thrusts mainly composed of Archaean gneiss and schists in Great Himalaya with thin layer of limestone over 8000m on Kangchendzonga massif; closed folds occurring in Trans- Himalaya having fossiliferous sedimentary formations of Tertiaty period.	1. Highly rugged summits permanently covered with ice and glaciers; cirques with high, steep headwall, jagged arêtes, and medium to long glacial terraces generally adorned with ice cornices and seracs (absent in eastern part).
2. Upper part of the Lhonak basin	2. Series of small to medium Transverse faults offsetting the Northern Boundary Fault; surface rocks are Archaean gneiss,milonite and schists with intrusions of pegmatite of later ages; limestone, flagstone and other Tertiary sedimentary rocks found along the northern ridges.	2. Wide glacial valleys with hanging ones on both sides of the trunk streams, bedrocks are marked by rock pedastals, friction cracks and sichelwannens.
3. Upper part of the Lachen chhu valley	3. Northern Boundary Fault is concealed beneath the thick layer of Pleistocene till deposits; northern subdued ridges are composed of fossiliferous shale, sandstone and greywacke; black	3. Shallow and thin thalweg rolling down through a wide glacial valley of the last Ice ages flanked with high trains of lateral moraines; scattered erratic boulders over smooth layer of ground moraines; all features are being

	limestone noticed on eastern hill slopes.	modified by strong wind action.
4. Tsen-gui kang ridge including the gorge of lower Lachen chhu	4. Extended thrust composed of Archaean gneiss and schists showing crumpling and fracturing cross-sections; often found granitized rocks; mineralization of rocks with high concentration of feldspathoids.	4. Badly weathered ridge festooned with rock streams and debris flows; narrow V-shaped valley flanked with frost-shattered rock debris; in-valley section sometimes clogged with drumline-type mounds of tills.
5. Lower Lhonak basin with Zemu valley	5. Deeply faulted area; rock benches high above the valleys are very common which are the result of neo-tectonic upliftments.	5. Summit section of the water divides is featured by frost- shattered rocks; ridge slopes show striations caused by paleo-glacial abrasion; lower valleys are skirted with kame terraces which are discontinuous due to vigorous attack of sub-aerial erosion.
6. The Lachung basin	6. Series of small faults and ruptures in Archean bedrocks; Hot springs are present at short distances.	6. Wide 'U'-shaped valley borne with palaeo-glacial landforms like broken cirques, curtailed arêtes and shortened rock pinnacles; deep ravines in upper part but shallow meandering valleys in lower part with slender pro-glacial channels.
7. Dongkiya and North Chola Range	7. Massive thrusts with Archean gneiss and schists; often exposed milonite, migmatite and other types of metamorphic rocks of Late Proterozoic to Cainozoic	7. Badly weathered crests with highly dissected slopes due to the downcutting action of innumerable rivulets; kame terraces along valley sides; erratic boulders at

	eras in deep valleys; intrusion of granite, pegmatite and syenite is found in axial part.	the valley-bottoms.
8. South Chola Range with De chhu basin	8. Low-angled thrusts composed of Archean gneiss with intrusions of granitoid, grano-diorite and peridotite at the fault planes.	8. Rounded crest-line with occasional sharp pinnacles; hill-slopes and valley-floors are adorned with patterned rocks caused by periglacial action.
9. The Tista basin including Rongni chhu and Rangpo valleys	9. A deep Transverse fault act as the link of the Main Central Thrusts ; minor faults offsetting the former; complicated plunging folds along the westlying water divide; inverted strata of Palaeozoic Era (phyllite, schists) to late Tertiary period (sandstone, conglomerate,etc) are exposed in lower velley sections.	9. Multi-terreced valleys formed by neo-tectonic movements; wide meandering channels guided by interlocking spurs; hill slopes are receding rapidly due to differential denudation processes. Wider valley-floor of the Tista with huge bed-load deposition after crossing 450m contour.
10. The basin of Talung chhu	10. Northern Main Central Thrust running below the valley of the Trunk stream; minor faults guide the tributaries; horneblende-gneiss, syenite and coarse granite occur in the valley-walls.	10. Structurally controlled rectangular pattern of drainage system headed with cirques; narrow deep stream-valleys skirted with gently sloping glacial terraces; shifting tendency of the Trunk valley towards south resulting asymmetrical profiles throughout the length.
11. Singalila Range (Northern part)	11. Typical nappe started from Northern Main	11. Badly weathered summit section with a series of

	Central Thrust, broken at places by parallel Transverse faults; partly metamorphosed quartzites and other Permian – Carboniferous rocks are overlain by Archaean granite-gneissic structure.	rock pinnacles; projected spurs are truncated by the lateral erosion of the river Baro Rangit and its preceding glaciers.
12. The basin of Bari Rangit	12. Complicated net of faults (medium to small scales) in Archean strata; younger series are exposed at the valley bottoms and around Namchi area; hot springs are found at the convergent plane of faults (little north of Jorethang), garnet and calcite are abundant in granites; augen-gneiss found in upper layer of the strata.	12. Ideal dendritic pattern of drainage system developed with innumerable rivulets and springs; incised meandering course found in the main valley with picturesque depositional features at its base.

Concluding Remarks

Although the region under study provides many examples of past glacial covers all over the tract fluvial processes are dominant at present. The river valleys are widening with continuous receding of cascades and terraces. The evolution of landform is, however, interrupted frequently by neo-tectonic movements. Rupturing in rock strata, creation or collapse of caves, springs (hot and normal), retreat of hill slopes, sharpening of water divides, avalanches (rock and snow), and frequent change in stream thalwegs are common phenomena found in every part of the terrain. The effect of Global warming is diminishing the glaciers over the mountain tops (especially between 5500 m and 6000 m elevations) as well as the periglacial features in De chhu basin. In short, the Sikkim Himalaya is an ideal example having a large variety of geomorphic settings across the entire Himalayan system.

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An Appraisal of Ground Realities of Deprivation among the Beedi Workers in Tufanganj-I Block of Cooch Behar District

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Abstract : *Beedi is one of the biggest unorganized or informal sectors in India. This sector helps to alleviate the economic condition of rural and semi-urban people of India. Women's participation rate in this sector is quite high, because it can be carried out from home without disturbing their regular duties at home. As these workers mainly belong to lower economic class, they are being exploited by the agents. Continuous contact with tobacco causes harmful diseases to the workers especially muscular and respiratory problems are profound among them. The present paper shows ground condition of the beedi workers in Tufanganj-1 block of Cooch Behar district and also tries to find out the reasons behind deprivation of beedi labours.Thispaper also throws light on the ongoing scheme and their implementation in the study area.*

Keywords : *Beedi Rolling, Informal sector, Beedi Cards, Respiratory problems.*

Introduction

A beedi consists of about 0.2 gram of processed sun dried tobacco flakes, rolled in a tendu leaf or temburni leaf and then tied with cotton thread (Ansari & Raj, 2015). Beedis are more popular among Indians because of its cheaper value than cigarettes. There are approximately 800 million bidis are sold in India in each year, outselling by a ratio of 8 to 1(Purkait, 2015). Beedi rolling and its production is one of the dominant works in several districts of West Bengal. Murshidabad, Malda, Uttar Dinajpur, Cooch Behar, Purulia, North 24 parganas, Nadia and Purba Medinipur are the home to many large and small beedi factories. Huge workforce ofTufanganj-I block in Cooch Behar district, is engaged to this cottage industry and earn their livelihood. There are two types of engagements in this sector, one is casual system, and another is 'Kena- Becha' system. In 'kena becha' system, workers are associated with small factories and get wage rate lower than casual system.

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Mostly women are associated with this sector as it is very easy to learn and they can work from home. Women and also the other workers in this sector are less educated, so they are easily exploited by the Munshi or agents. Working pressure for 6 to 8 hours affects them with various physical health problems such as respiratory problems, numbness, muscular problems and back pain (Mettilda et al. 2008;Srinivasan et al. 2013;Hoque, 2018). As most of the workers are indirectly associated with the industry, so they don't get the registration cards also. As a result, they become deprived of the health and social benefits given by the Government (Ansari, 2015; Sudina et al. 2016). The present paper tries to represent the scenario of beedi workers of Tufanganj-I block, their deprivation of social and health benefits and even their rights to minimum wage rate.

Location of the Study Area

Cooch Behar district is homeland of beedi production and it is an important district of North Bengal. This district has 12 C.D. blocks among them Tufanganj-I has higher concentration of Beedi labours. The block covers an area of 317 sq.km. and according to 2011 Census Report 248505 peoples live here. Present study area extends from 26°10/ N to 26°23/N latitude and 89°31/E to 89°42/ E longitude (Fig 1).

Objective

Present study aims at analysing the discrimination faced by the beedi workers in case of wage rate and financial aid giving by the government.

Methodology

This study is categorically based on primary and secondary sources of data. In depth Questionnaire method survey has been carried out throughout the study area on 2018 to collect primary data & information. The survey was perpetrated on randomly selected 50 households of Deocharai, Uttar Chhat Jaigir Chilakhana and municipality areas of Tufanganj- I block where concentration of Beedi worker is much high. The respondent for this survey is selected on the basis of their occupation which is Beedi Rolling. Local Governmental body and Labour Welfare Office of Cooch Behar district were consulted by the Researcher for various secondary data. All the data were then statistically represented with MS Excel 2007.

Results and discussion

Ground realities of beedi workers:

Working-hour: According to the study females were more active regarding beedi rolling process as it is easier for them to maintain work and home simultaneously. 58% of the respondents worked for above 5hours a day and some workers even work for 8 to 9 hours to bind maximum amount of beedi (Table 1).

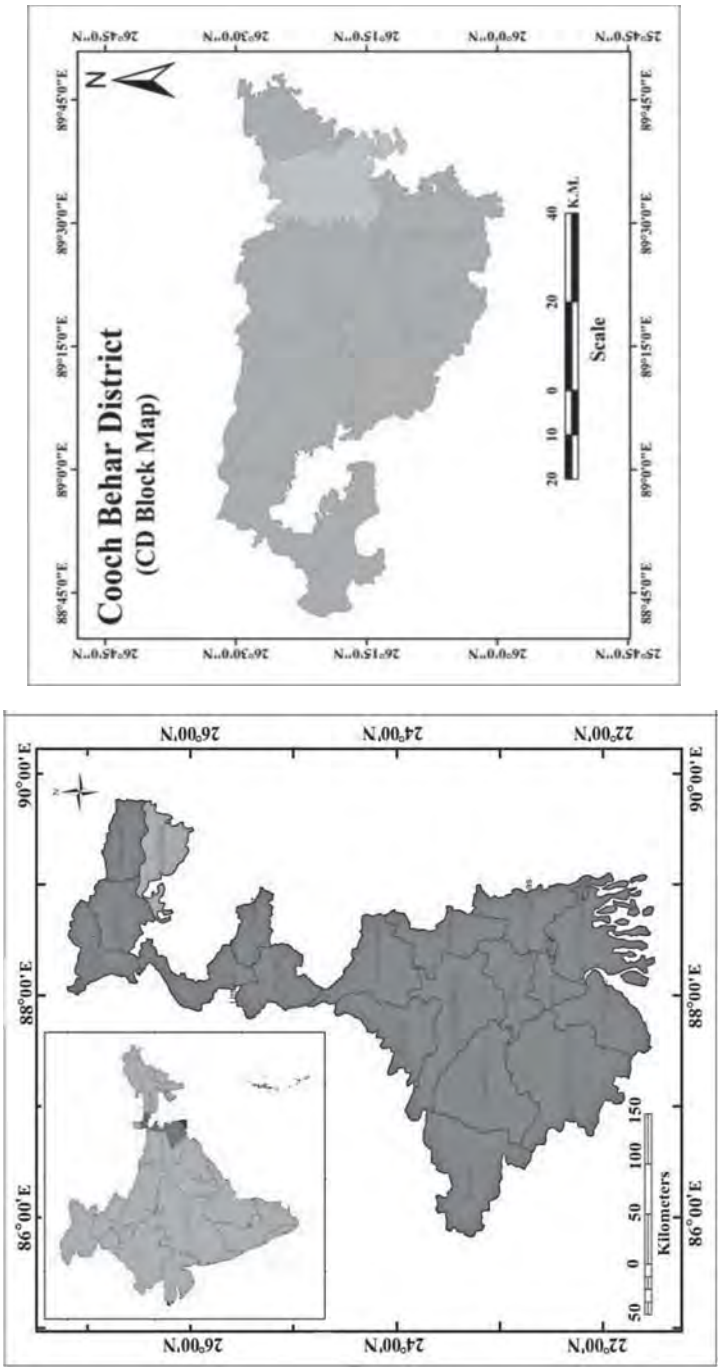

Fig. 1 Location Map of the study area

Table 1 Hours spent on beedi rolling

Working Hour	% of frequencies
Less than 2	4
2 – 3	8
4 - 5	42
More than 5	58

Source: Field Survey, 2018.

Wage rate

For monitoring the social security of beedi workers Government of India has legislated Minimum Wage Act and Provident fund act. Rs. 169/- per 1000 beedis is national wage rate, but Labour Commissioner of Government of West Bengal and Beedi Merchants' Association (BMA) restricted it as Rs. 126/- for 1000 beedies. Those people who are not registered they got Rs. 100/- per 1000 beedis in kenabecha system.

In Tufanganj-I block, variation can be seen in wage rates from semi-urban areas to rural areas. Workers of the municipal areas get 120 to 115 rupees per 1000 beedis which is near about the standard wage rate accredited by Labour Commission(Fig 2). In rural areas wage rate reduces

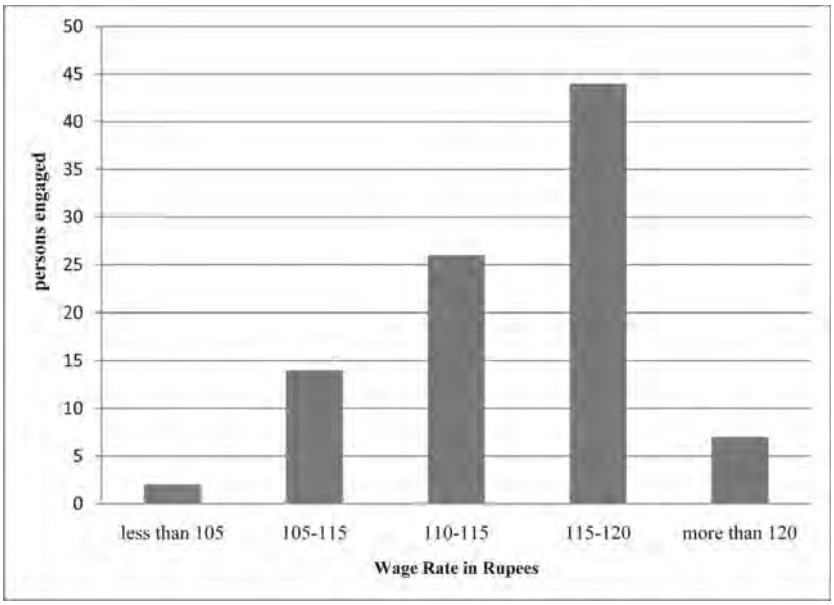

Fig. 2 Variation of wage rate among the beedi workers

Source: Field Survey, 2018

because of the existence of agents, who charge commission 20 rupees per 1000 beedis from worker. As a result, wage rate becomes 105-115 rupees per 1000 beedis.

Presence of Middlemen or Munshi

Munshi or the middlemen are a major problem associated with this working sector. According to the report of the survey (Fig. 3) majority of the workers are indirectly appointed with the organisation, as they handover beedis to the munshi. 14% of the respondents directly handover to the industry. Existence of middleman can be observed here as beedi industry is located far away from the villages and people are reluctant to go to handover beedis directly to the industry. Then they have to give commission to the munshi for rolling 100 beedis. Although these middlemen got Rs. 5.40 for submitting 1000 beedis to the factories. They also deprived the workers in case of providing raw material to roll beedi. 500 grams of tobacco and 800 grams of tendu leaves are essential ingredients to roll 1000 beedis but in the study area those 86% of the respondents reported that they only got 350 grams of tobacco and 650-750 grams of tendu leaves. Hereof the workers have to purchase raw materials from munshis. Even munshi rejected rolled beedis for insufficient raw materials or for any mistake in binding. Survey report shows that 44% of the workers faced rejection of 2 to 3 bundles of beedis every week (Fig. 4). The middlemen sold those rejected beedis in the factories in lower price but the workers remained deprived of their wages.

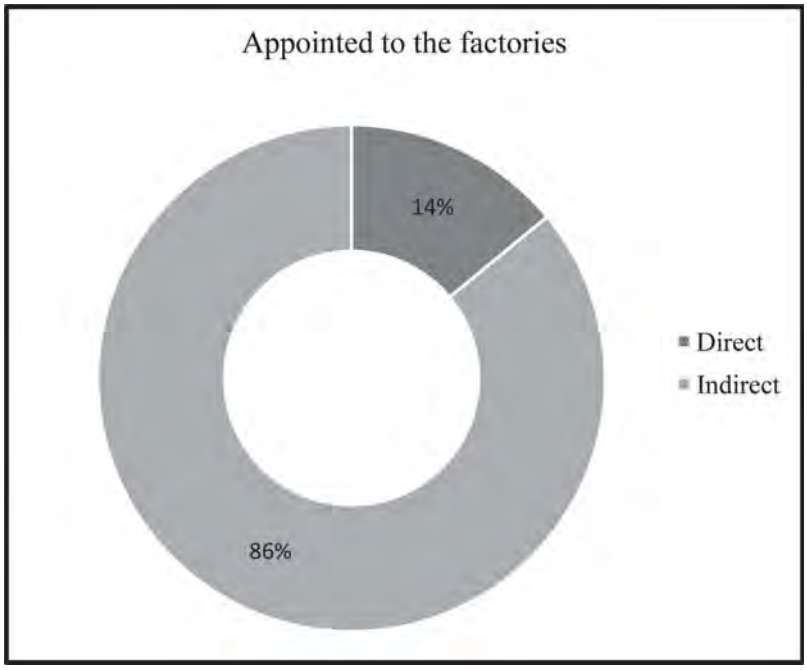

Fig. 3 Mode of appointment to the beedi factories

Source: Field Survey, 2018

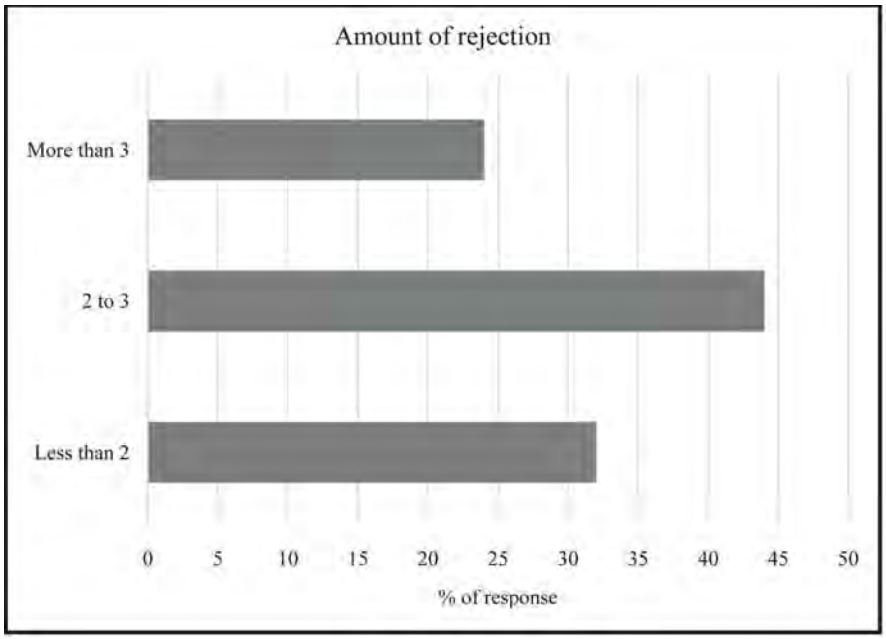

Fig. 4 Rejection of beedis

Source: Field Survey, 2018

Sources of substitute income

The work of beedi rolling is very monotonous and the wage rate is also lower than other sectors like agricultural labour, daily wagers or shopkeeper. So, in the study area 36% people have selected this occupation as their main source of income but 64% of the respondents are now diverted to another work. Among the 64% people mostly women are connected with this occupation and they do it for the future savings and educational attainment for their children. But aged people are reluctant to continue this job as they are facing both economic and health issues.

Beedi card registration

Among the respondents, 80% workers do not have beedi card registration. They are basically informal workers and do not aware of the benefits of registration and the process of beedi card registration. Munshis took this advantage and deprived them from PF or even getting health schemes and educational grants.

Health Status

Beedi labours spend 6-8 hours per day for rolling beedis. Work pressure and continuous contact with tobacco cause many health problems in the study area. Among those diseases, respiratory problems, eye problems and muscular numbness are prominent. Some people cannot

avail medication due to lack of money. Govt. of India has initiated some health care facilities, which are:

1. Beedi workers can get assistance up to rupees 30000 for minor surgeries like Hernia, Gynaecological and appendectomy etc.
2. Upton rupees 1, 30,000 are given for cardiac diseases and also 2, 00,000 rupees are given for kidney transplant.
3. For controlling population growth, there is also provision of rupees 500 for sterilisation.

But the amazing fact coming from the ground survey is that beedi workers did not get such type of health care facilities. Only those labours residing beside the district head-quarters get some facilities from Beedi Welfare Office. Health camps were organized by the Beedi Welfare Commission and by some NGOs in different villages of Tufanganj-I block, but only six respondents said that they went there for checking up. The reason for this scenario is the registration of labours, as they don't have beedi card, so they are not eligible for such free check-up.

Educational scenario

For promoting education among the beedi workers' children, govt. has given various grants, they are listed below (Table 2):

Table 2 List of Educational Grants

Sl. No.	Standard	Financial aid per year (in rupees)	
		Boys	Girls
1.	I-IV	250	250
2.	V-VIII	500	500
3.	IX	700	1140
4.	X	1400	1840
5.	XI-XII	2000	2440
6.	College	3000	3000
7.	Technical Education	15000	15000

Source: Report of Centre for Health & Social Justice, 2017

Inspite of such financial assistance enrolment of beedi labours family members in schools or higher education is less. From the survey it is clear that 29% of the respondents are illiterate, whereas in colleges and universities this trend slows down to only 11%. Survey report reveals that only 24% respondent's families got scholarships from the government. Only two girls among the

respondents got Kanyashree Scholarship introduced by the State Government of West Bengal. Children of the beedi labours are forced to leave the education after schooling as they do not have any scholarship to support them economically, especially the girl children simultaneously roll beedi with their education.

Reasons behind deprivation:

1. **Poverty:** Respondents of the study area mainly belong to lower middle-class families. So, they have to choose this work for earning and supporting financially their families. From the survey it is found that in most of the family, women are engaged in this work and as this work can be done from their houses so they find it easy than other work. So, they agree to do it at lower wage rate.
2. **Education:** education is another vital factor for choosing this sector and also deprivation. As most of the workers are either illiterate or they have only primary education, they can't be appointed in other sectors.
3. **Unawareness:** respondents are not aware about the ongoing schemes implemented by Govt of India and also state govt for their welfare. Many workers face health issues specially the aged workers but they can't rejoice the benefit of beedi cards as they don't know how to apply and who can help them. There is a big gap between govt authority and the labours, so the benefits of that welfare programs are worthless**.**
4. **Agent system:** Agent or munshis act as middleman between factory authority and workers and they try to earn profit from the workers.They supply raw materials of beedi to the labours for binding but from the survey it is clear that agents give only 350-400grams of tobacco for binding 1000 beedis whereas 500 grams needed for making that quantity of beedis. As a result, respondents either have to buy extra tobacco mix or their rolled beedis are rejected due to shortage of tobacco leaves. In both cases workers have to face loss of wages.
5. **Presence of small factories:** In Tufanganj-i block many small factories have been established and these factories do not register their workers. As a result, beedi workers whoever directly appointed to this kind of factories can't get beedi card and get wages lower than the big factories.

Concluding remarks

Although beedi rolling sector is causing placement of huge workforce in both India and in our study area, but the ground realities of those work force are very pathetic. They don't get their wage rates in time due to rejection of beedis and commission of agents.2-3 bundles per hundred bundles were rejected by the factory members. They then did not get the right prices or otherwise they have to sell it in half price to the agents. Unawareness about the health schemes and educational grants

are also reasons of backwardness among them.They remained deprived as the existence of middlemen and the Beedi Welfare Organization are now trying to identifying the unregistered beedi workers for giving them the Governmental assistance. But the main issue in this purpose is the distance, as the office located in district headquarters only so the people of remote areas of villages are not getting information about beedi card registration and also the health camps. The study thus reveals how they are deprived of their basic rights in workplace and wages.

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Site and Situation of Settlements in the Rammam Basin, Darjiling - Sikkim Himalaya

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Abstract : *Settlement is a sheltering place of man and is one of the most important characteristic features of human civilization all over the land of our planet earth. It is an admixture of several households each of which is generally occupied by individual family of a society. The mountainous tract of Rammam basin reveals some unique site and situational characteristics of the settlements which are to some extent inaccessible due to rugged mountain terrain. The basin is not only a rugged region but also shows the least developed communication system. All habitations in the terrain are of rural in nature but exhibit different types of activities. The varied characteristics as well as the size of the settlements grown here depend largely on the site and situation of their own. In the present paper, attempts have been made to analyse the site and situational characteristics of the habitations and also to understand the processes of selecting sites among the various communities living on this tract.*

Keywords : *Spur settlement, Mountain saddle, Adret, Ubac.*

Introduction

The origin of a settlement depends on a site – a particular characteristic of space which some people find suitable for habitation purpose. Paul Vidal de La Blache (1926) in his book *Principles of Human Geography* emphasized on site of human establishments as '*it is the one in which geographical influences seem to stand out most prominently.*' Situation, on the other hand is the relation of one settlement with the surrounding settlements through the varied linkages (Singh, 2013). It also refers to the centrality or accessibility of a settlement within the vast region. The settlements located at the nodal points always enjoy its situation and grow faster due to their better connectivity to the surrounding areas. The origin, growth and decay of any settlement thus depend on both of its site and situation.

In the mountainous tracts of Rammam Basin, summit line, break of slope, confluence points of streams, river terraces, river side, spurs and edge of forests are the suitable sites where settlements

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have been set up. The inhabitants of this basin have chosen their settlement sites wisely keeping in mind the availability of agricultural and pastureland, drinking water and other products which are important to sustain life. It has also been observed that the communities living in the basin respond to their environment differently. Thus the study of settlement site and situation is very important to understand the people and their relation to environment in the Rammam Basin.

Objectives

The objectives of the following paper are as follows:

1. To find out the favourable site and situation of the settlements in the study area.
2. To find out the influence of culture of the communities living in this tract in selecting sites of their settlements.

Methodology

The paper is based on field surveys of the study area during different periods of past four years from 2016 to 2019. Besides primary data, some secondary data on total population and number of persons belonging to different communities living in different hamlets have been collected from Census of India, 2011 and from Gram Panchayat offices of Daragaon and Rimbick respectively. In addition the topographical maps of Survey of India and Google earth images have also been observed to understand the sites of the settlements.

Location of the study area

The Rammam basin is one of the most distinguished basin areas in the Darjiling-Sikkim Himalaya which is world famous for its several viewpoints such as Singalila, Phalut, Sandakphu and Tonglu along with some picturesque settlements like Gorkhey, Samanden, Gurdum, Rimbick, Ribdhi, Okhre, etc. The whole tract is divided into two unequal parts: the North and South Rammam Basin. The North Rammam Basin comprises the south-western part of West Sikkim and the South Rammam basin occupies north-western part of Darjiling district (mostly under Lodhama and partly under Sukhiapokhri and Pulbazar police stations) in West Bengal. The main river Rammam marks the boundary between the two said parts and exits the terrain near Nayabazar for plunging into its trunk river - the Great Rangit. The length of the river Rammam is 42km. The altitudes of the entire basin vary widely – from 3685m on the Singalila peak to 315m at the confluence point of the river Rammam and Bari Rangit, below Nayabazar. Total area of the basin is 403.16 km^2. The latitudinal extension of the study area is from 27° 022 N to 27°152 N; while the longitudinal extension is from 87°59´E to 88°17´E.

Settlements in the North and South Rammam Basin

There are 19 village units, one notified bazar area and four forest blocks in the North Rammam Basin and 14 village units in the South Rammam Basin. Each village unit consists of several hamlets. The village units may be under one, two or even more Gram Panchayats. For example, Singalila

forest village consists of 12 hamlets falling under four Gram Panchayats. The name of the village units including the number of households and total population have been tabulated below:

Table 1: **Villages along with number of households and total population lying in the north and south of river Rammam**

Sl. No.	Sub-basin	Villages	No. of Household	Total Population
1	North Rammam	Bhareng, Ribdhi, Okhrey, Tikpur, Siktam, Salyangdang, Lungchok, Dhalam, Timberbong, Upper Fambong, Lower Fambong, BurikhopRumbuk, Burikhop Dodaak, Tharpu, Soreng, Malbasey, Chongbong, Rumbuk, Nayabazar (NA), Karthok, Nayabazar Forest Block, Soreng Forest Block, Sombaria Forest Block & Hilley Forest Block	6949	32170
2	South Rammam	Singalila Forest, Rimbick, Namla, Lodhama, Hatta, Kankibong, Jhepi, Lamagaon*, Kaijalia*, Samalbong*, Kolbong, Murmidong, Karmi & Goke*	7346	35687
		Total	**14295**	**67857**

(*Village partly under Rammam Basin); *Source: Census Data, Government of India, 2011*

Physiography of the Rammam Basin

Physiographically the region belongs to the Lesser Himalaya being composed of huge 'Nappe' projected from the north lying mountain massifs of North Sikkim. The westernmost wave of the structure makes the highest mountain of the terrain and is well known as the 'Singalila Range'. The

Table 2: Length of some important rivers and ridges:

Rivers	Length (Km)	Range/Ridges	Length (km)
Rammam	42	Southern Singalila Range	40
Kali Khola	08	Kingsa Danra	06
Rato Khola	06	Sabarkum Danra	07
Siri Khola	12	Sandakphu Danra	06
Lodhama khola	14	Rimbick Danra	11
Jhepi Khola	08	Deorali Danra	10

Source: Topographical Map No. $78^{A}/_{8}$ & $78^{A}/_{8}$

Range stretches from Kang peak (5850m) lying south of the great Kangchendzonga-Kabru massif and abuts on Tonglu (3070m) –traversing a distance of more than 70 km. The crest line of the Range indicates the International boundary between Nepal in the west and Sikkim-Darjiling of India in the east. The basin Rammam lying east of the mountain i.e. situated in Indian Territory contains many settlements with their diversified characteristics. All these settlements are confined in a triangular landscape: the crest line of the aforesaid mountain to the west, Singalila – Sungri ridge to the north-east and Tonglu - Lamagaon ridge (Deorali Danra) in the south-east.

The sites of settlements

I. Site of settlements depending on physiographic characteristics

The settlement sites in the Rammam basin mostly depend on the physiography of the basin. As the basin under study is a rugged tract and is characterised by several ridges and valleys so the physiographic characteristics play important role in the growth of settlements over them.

A. Spur settlements

In the south Rammam Basin several ridges extend eastward from the Singalila Range. From south to north these ridges are Deorali Danra, Rimbick Danra, Sandakphu Danra, Sabarkum Danra and Kingsa Danra in the South Rammam Basin. The orientations of these ridges are from west to east and are almost parallel to each other. The settlements are located on various spurs projected from these ridges at various altitudes. Bichgaon, Sepi, Kankibong, Jhepi, etc. are good examples of such settlements.

On the northern part of Rammam Basin, Singalila – Sungri ridge extends from west to east and creates the water divide between the river Rammam in the South and river Kalej Khola in the north. The spurs projected from this ridge are in north to south direction. Settlements have been developed at the southern end of these spurs such as Bhareng, Ribdhi, etc. Altitude of all these settlements, both in northern and southern parts of Rammam Basin, varies widely – from 1000m to 2200m.

B. Summit-line settlements

There are some summit-line settlements which are located at and above 3000m altitude along the main Range of the Singalila. These settlements are categorically mountain-view points such as Tonglu, Sandakphu, Sabarkum and Phalut. The settlements grown over the crests are tiny hamlets and suffer from scarcity of water.

C. Settlement Site with high insolation

The settlements growing on projected spurs are very much dependant on the amount of insolation. Thus the ‘adret’ (sunny side) of the ridges is primarily chosen for the growth of any settlement. Such sites are protected from chill northerly winds too by the crags lying over the summit section of the ridges. High amount of insolation increases not only the surface temperature of the place but also helps to grow the crops rapidly. Almost seventy percent of the settlements in the Rammam Basin are either located on the eastern or southern slopes of the ridges. Danragaon,

Gumbadanra, Yakrebong, Namla, Lodhama, Kankibong, and Jhepi in the southern part and Bhareng, Ribdhi, Okhrey, Sombare, Dharamdin, etc. in the northern part of the basin are villages of best examples of such adret location. Due to higher amount of solar energy falling on the adret side location of Yakrebong (1300m), paddy is cultivated here during monsoon months.

D. Fault-base site

Gurdum is located at the base of a large cliff created by a Reverse Fault in Gurdum danra (Ridge) with a large cliff. Establishment of this settlement is evident as the people residing here receive several opportunities from nature. They get forest products grown over the upthrow side, supply of water from perennial springs issued at the base of the Fault plane, gets shelter from the chill Katabatic wind along the ridge top and get also the advantage of gardening and farming on fertile soils deposited at the downthrow side.

E. River terrace

Lodhama Bazar (Budhwari) is the best example of a river terrace settlement as it is located at the lower terrace of the river Lodhama Khola. This settlement is located at the right bank of the river Lodhama. The altitude of this settlement varies between 1050m to 1090m. This settlement is one of the oldest haats (weekly Market) of this region. On the northern part of Rammam basin Dharamdin (Dhalam) is located on the middle terrace of the river Rammam at an altitude of 1200m.

F. Mountain Saddle

Any depressed land along the mountain range always attracts people to set up hamlet as it exhibits several facilities – protection from chill mountain wind, abundant supply of water (from springs), thick soil layer, relatively stable landmass, etc. Such site is locally known as 'Bhanjyang' (a Nepali word). Kaijalia (1100m), Daragaon Bhanjyang (2062m) are examples of such type of settlements.

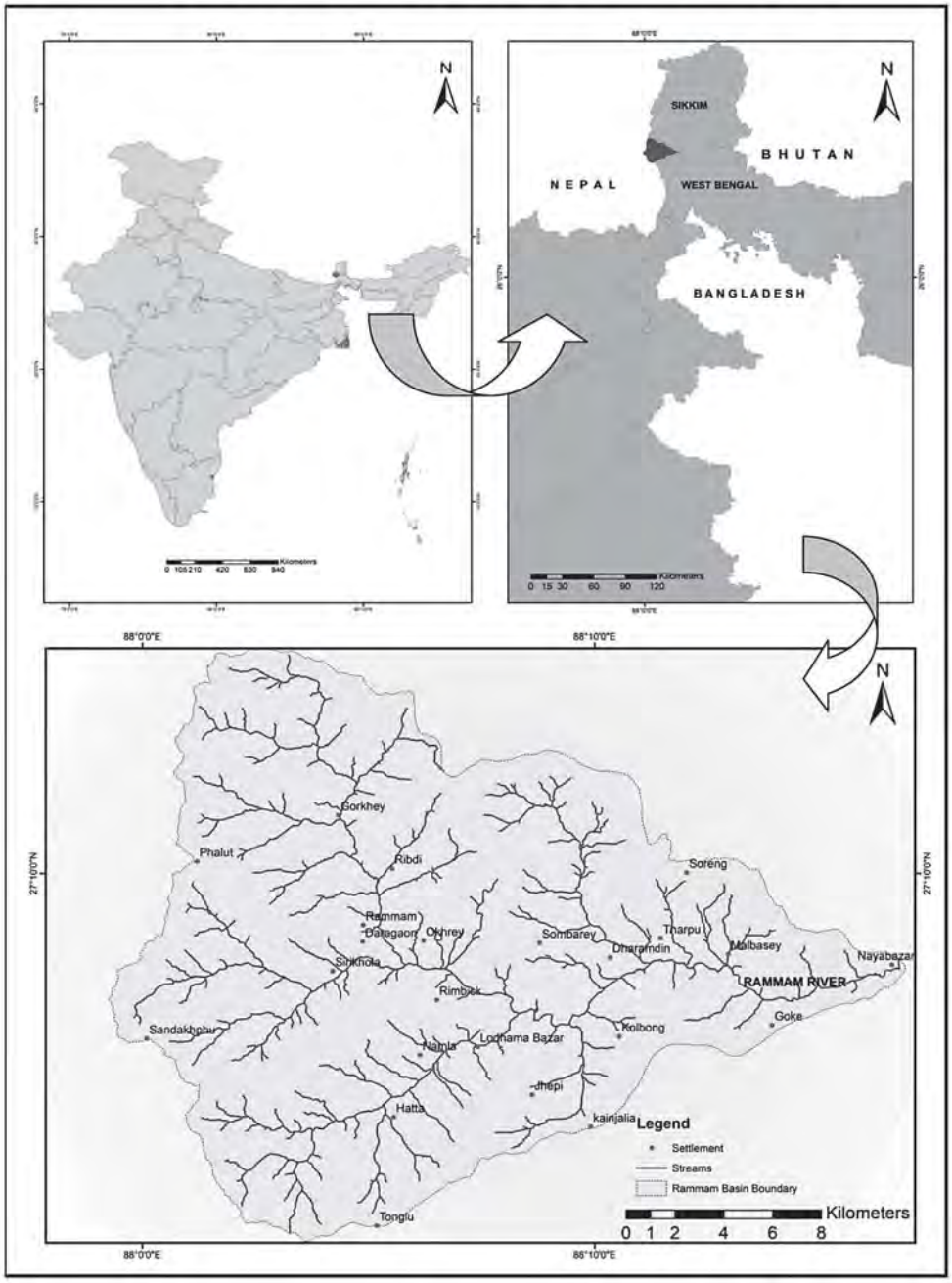
G. Wet point

Any settlement grown for human habitation requires the supply of water. The settlements lying over the ridge tops and summit section of the region under study suffer a lot due to lack of water, but at least two wet point hamlets (army camp) have been set up in the area under study. Both of them are located over the summit-line. The highest hamlet is Thakum (3400m) which receives water from a tiny lake named Chandu Pokhri about 400m away. The second one, Batasi, is dependent on spring waters. Altitude of this hamlet is slightly lower – 2900m.

H. Flat land for Agriculture

The villages such as Samanden and Dhalam are the two settlements where flat land for agriculture is available. The people of these two villages are mainly farmers. They raise their crops like Paddy (at Dhalam), Maize, Buckwheat and different types of vegetables over the flat lands of the hamlets.

LOCATION MAP OF RAMMAM BASIN



I. Forest Edge

Gorkhey is such type of settlement which is located at the edge of the Singalila National Park. Besides, Samanden, Rammam, Upper Daragaon (Kalyan), Upper Bichgaon, Upper Sirikhola, Gurdum all are located at the edge of the Singalila National Park and all these are forest villages. The inhabitants of these hamlets depend largely on the forests for their livelihood. On the northern part of Rammam Basin, Burikhop is located at the edge of Soreng Forest. Such forest edge settlements enjoy rearing of bovines as the forests provide ample supply of fodder for these animals.

II. Site of Settlements preferred on the basis of cultural traits of different communities

Site is a geographical space over which man establish his habitation. According to Paul Vidal de La Blache (1926) '*nature prepares the site and man organizes it to enable him to satisfy his desires and his needs'*. This approves the fact that the very concept of site is inherently cultural (Singh, 2013). Man prefers to live in those places which provide the materials for his living such as food, drinking water and building materials. The methods of acquiring such materials are not same for all groups of mankind. For this reason some places seem favourable to some people whereas others find the land unsuitable for their habitation. The places chosen by various communities for establishment of their settlements in the Rammam basin are thus specified as follows:

A. High mountain settlements of the Sherpas

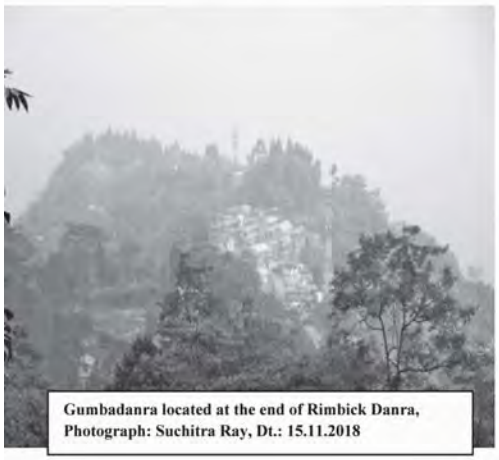
Altitude of settlements in the Rammam basin varies from 450m at Nayabazar to 3631m at Sandakphu. Maximum number of settlements in the basin is located between 1000m-2000m altitudinal belt. But there are few hamlets which are located above 2000m, such as Manedanra, Gurdum, Upper Sirikhola, Bichgaon, Upper Daragaon, Rammam, Samanden and Gorkhey in the southern part; and Bhareng and Ribdhi in the northern part of the basin. Major part of the inhabitants at these hamlets belongs to the Sherpa community – 30% to 100%. The Sherpas are original inhabitants of eastern part of Tibet (average altitude being above 4500m). Form this land they migrated to eastern part of Nepal at Solu-Khambu region. From there some of them migrated further east and crossed the Singalila Range to be settled at these higher altitudinal settlements in the Rammam Basin. The Sherpas are basically herders and rearing of yak was once their principal mode of living. But now-a-days they rear dzoes (male) and dzomo (female): the hybrids of Yak and cow. The lifespan of Yaks as well as the amount of their milk (of Nak, female Yak) decrease below 3000m. On the summit line the Sherpa people make their 'Goth', i.e. the temporary shelter for animals and men while travelling across the mountain looking for fodder of their herds. They live at the Goth from spring to autumn and come down to their permanent settlements after starting of heavy snowfall during the winter months. Besides rearing of bovine animals, the Sherpas also do some cultivation in their small landholdings mainly for the consumption of their family, though they sell the surplus production at local bazar. As this altitudinal belt is located on the famous trail of Manebhanjyang-Sandakphu-Rimbick, so many settlers of these villages now-a-days have engaged themselves in tourism business.

Lodhama Bazar at river terrace of Lodhama Khola
Photograph: Suchitra Ray, Dt.:17.11.2018

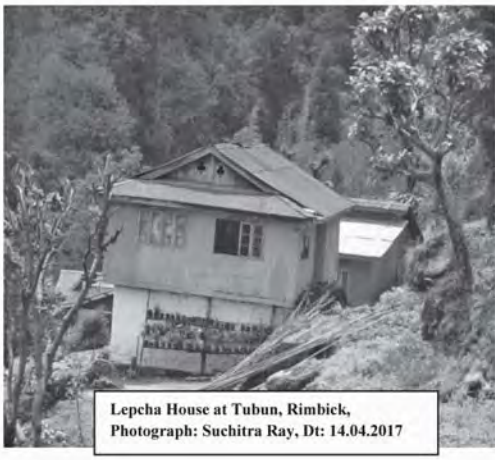
Ribdhi, a settlement located on spur
Photograph: Suchitra Ray, Dt.: 18.05.2016

Paddy Field at Yakreybong (1300m) – an adret site settlement
Photograph: Suchitra Ray, Dt.: 17.11.2018

Flat agricultural land of Samanden
Photograph: Suchitra Ray, Dt.: 18.05.2016



Gumbadanra located at the end of Rimbick Danra,
Photograph: Suchitra Ray, Dt.: 15.11.2018



Lepcha House at Tubun, Rimbick,
Photograph: Suchitra Ray, Dt: 14.04.2017

B. Low-lying valley settlements of the Nepalese

The people migrated from the west lying Nepal territory are very much enthusiastic in nature and are well adept in cultivation. Hence the mid altitudinal belt (1000m – 2000m) is always preferred by these people as the temperature is favourable for cultivation in this belt. They cut terraces along the slopes of the ridges and produce paddy and other vegetables. The homesteads of the Nepalese are set up along the break-of-slopes lying in between their arable lands and pastures. Lower Daragaon, Dilpali, Namla, Lodhama, etc. are best examples of such settlements.

C. Site for Lepcha Settlements

The Lepchas are the first community making their settlements in the Rammam basin. They are directly dependant on nature for their living still today. Hence the settlements of the Lepcha people lie generally on the steep slopes of the ridges where they find small piece of land for producing their food stuff by rudimentary methods. Since the growth rate of these people is very low (most probably in the effect of their consumption of some natural forest products) the number of households in their settlements is also very few and has been growing at very slow rate. The small settlements resided by the Lepchas are mainly concentrated in the hamlets like Tubun, Gumbadara and Yakreybong in the Rimbick Gram Panchayat.

Situation of the settlements in the study area

Whenever a settlement is established in a favourable site, it tries to grow with time. But the rate of growth depends primarily upon its situation, i.e. its relative location (Broek and Webb, 1980). Like other alpine settlements of the Himalaya the situation of settlements of the basin under study can be enumerated as follows:

A. Mountain View point

Some places across the summit section of the Singalila Range are very much suitable for viewing the magnificent sceneries of the high snow-clad mountains of the Great Himalaya. Sandakphu, Phalut and Tonglu provide best examples of such places where small settlements have grown only for facilitating accommodations for travelers. There are four Trekkers' Huts along with one PWD Bungalow and two private lodges are situated at Sandakphu; while Phalut and Tonglu - both have a single Trekkers' Hut.

B. Halting point across the trekking route

Settlements may grow at a certain distance and at habitable places along the strenuous trekking route traversing the Ranges. For example the settlement like Gahribas has grown in the midway of the trekking route from Manebhanjyang to Sandakphu. Gurdum is another such settlement grown almost in the midway of the trekking path from Sandakphu to Rimbick.

C. Route convergence

At the point of route convergence settlements grow easily for the availability of transport facilities. Soreng is situated at such a point where the roads meet coming from Jorethang, Karthok

and Dentam. Kainjalia is another settlement where two roads intersect each other; one metalled road from Bijanbari to Rimbick connecting settlements of Chhoti Rangit Basin to the settlements of Rammam Basin, another is from Dhotrey to Goke (Boulder path).

D. Local permanent market and periodic markets

Rimbik and Soreng are two large agglomerations having fixed market place. Besides these two places, permanent market place can be seen at Lodhama Bazar, Jhepi, Kaijalia, Kolbong and Goke in the South Rammam Basin and Sombare, Soreng, Naya Bazaar (Notified Bazar Area) in the North Rammam Basin. All the essential commodities are sold at these markets. Rimbick and Lodhama Bazar are very old permanent Bazars and large amount of agricultural products (mainly potatoes) used to be marketed from these two bazars (Dash, 1947).

Over the study area, weekly/periodic markets are set up on various days. These weekly markets attract many buyers and sellers from distant places. Rimbick (Tuesday), Lodhama Bazar or Budhware (Wednesday), Dhotrey (Saturday), Bansbotte (Thursday) in the Southern Rammam Basin and Sombare (Monday), Soreng (Thursday) in the Northern Rammam Basin are such market places.

Changing Physico-Cultural Environment in the Rammam Basin and its impact on the site and situation of settlements

The changing physico-cultural environment in the Rammam basin during the last four decades shows enormous influence upon the site and situation of local settlements. The major changes are discussed briefly in the following paragraphs:

- The flash flood in the basin in 19th September, 1999 caused severe damage in the communication system of the terrain. Numerous landslides and landslips occurred just after the flood period which changed local landscape as a whole. Many small settlements completely washed away especially along the Siri Khola, Ribdi Khola and Riyong Khola. Some tiny hamlets were disappeared completely such as on the upper portions of Sepi, Lower Daragaon, Ribdi and lower portions of Okhrey, Tikpur and Siktam. The distressed families were to be shifted at safe sites of the said hamlets.
- Among the changes in cultural environment important aspect was found with the progress of Rammam Hydel Power Project in 1990's. For carrying building materials and equipments in the dam site (below Rajavir) as well as at the site of power generating plant (near Lodhama Bazar) motorable roads were constructed from the nearest bazar areas (such as Rimbick and Lodhama Bazar). These bituminous roads along with its branches (built in coming years) caused spectacular development of the settlements. The hamlet Gumbadanra (1600m) started to attract migrants from surrounding hamlets as the settlement site was proposed for various developmental activities (information collected during field survey at Gumbadanra in November, 2018). The number of homesteads increased rapidly along the road giving rise to linear settlement pattern.

- The formation of Darjiling Gorkha Hill Council in 1988 brought a great hope for the people residing in south Rammam Basin, i.e. in the part of Darjiling district. Hiking and tourism (due to the end of political unrests) increased manifold since early 1990s. In consequence of that number of trekkers hut and hotels also increased. The architectural characteristics of many old houses were changed on account of financial assistance by the administration. Thatched roofs were replaced by corrugated iron sheets, ground floors were transformed in to concrete structure and the transition of sanitary system was improved prominently.
- After completion of Rammam Hydel Power Project (Phase I) the settlements of northern Rammam Basin also began to be improved. Many home stays were established at Okhrey and some hotels were also set up at Okhrey and Soreng. In consequence of this tourism activities developed especially around these two settlements.
- Since the consciousness about local economy and polity has been growing among local people for last four decades, the cultural landscape of the terrain is developing rapidly. Every possible arable lands on the mountain slopes (except the areas of national park and reserved forests) are now being used for raising crops. The homesteads of each settlement are sprawling towards the extended fields for cultivation. This may cause areal extension of those settlements.
- The network of power supply (from Rammam Hydel Power Station) has spread out almost all over the settlements in the Rammam Basin. This has brought a tremendous change in the lives of local people. The economic activity has been diversified, market areas have developed largely, and many educational institutions have also been grown on the both parts of the river Rammam. Thus the areal extension of large settlements is increasing rapidly.

Concluding Remarks

From the above discussions it is clear that site and situation play vital role in the growth and development of settlements. Most of the settlements in the Rammam Basin are located on favourable sites as mentioned above and some of these settlements also have favourable situation which caused these settlements to grow rapidly. But some settlements in this basin are located on less favourable sites also such as settlements on the ubac side of the ridges. In many cases this type of settlements, if grown without its climatic consideration, is abandoned when a new settlement is grown nearby at favourable site. The Molle Trekkers' Hut is the best example of this type of abandoned hamlet. Now-a- days the trekkers take shelter here rarely but usually chose to stay at the newly constructed trekkers hut on the Sabarkum peak lying just below the summit crag. In spite of such exceptional case there are some ubac side settlements in the tract such as Hatta which is to some extent is a lee side settlement. The existence of these types of settlements in the basin can only be explained by increasing population pressure on the tract. As the population in this basin is increasing, people are residing at those places which in normal circumstances would have never been chosen as the place of settlement site.

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