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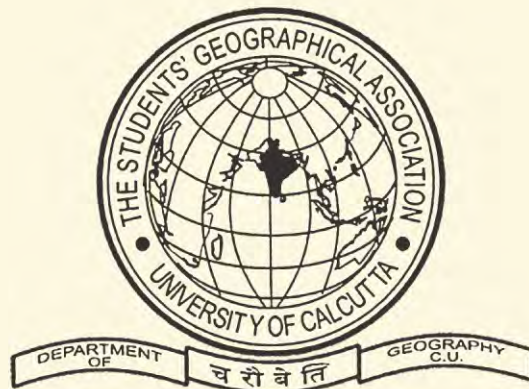
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A

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Editorial Note

Greetings! On behalf of the Editorial board of the journal "*The Observer*", it is my pleasure to present the 55th volume of the journal, a publication of The Students' Geographical Association, Department of Geography, University of Calcutta. "*The Observer*" started its journey in 1953 and got an ISSN [2230-9535] in 2011. Each volume of this journal is usually published at the day of reunion of the department.

This Journal intends to offer a forum for in-depth analysis of various dimensions of the subject matter of geography - social, economic, political, cultural, environmental and spatial transformations taking place across the globe. One of the objectives of this journal is to encourage publication from research scholars, teachers and students of geography. Over the years, The Observer has evolved into a vibrant, integrating and challenging. The journal includes up-to-date, and original quality contributions. It is supported by a competent editorial board along with a network of good researchers who contribute to selection, review and editing of the papers and articles. A call is put forth for papers from both physical and human geographers. Needless to say, a continuing flow of submission of good quality papers either individually or collaboratively, are much appreciated and will make a substantial contribution to the development and success of the journal. On behalf of the Editorial Board and the Editorial Office, I would like to express our gratitude to the authors and peers who have participated in the review process.

Sumana Bandyopadhyay

Editor in Chief & Professor
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Community Perception on Climate Variability and Related Water Issues at Southern Part of Rajnagar Block of Kendrapara District, Odisha

Upama Chatterjee ^{1*}

Abstract : *Community level perception on climate variability and related issues is needed to be discussed while talking about climate change and development of a region. This study focuses on the coastal block of Kendrapara district in Odisha. The study was conducted through semi-structured interview on 14 gram panchayats of Rajnagar block. Water sample has been collected from various tube well for quality testing. The objective of this study is to investigate communities' dependency on water resource for specific usage and the quality of drinking water, which is directly related to climatic variability. The study reveals that 42 per cent of the respondent thinks the effects of adverse climate impact lies upon 'reduced water availability, health issues and impact on agricultural production'. 28 per cent of the respondent reported the available water is not clean, and 18 per cent expressed their view that it is salty. With water quality assessment it has been found that the views of the respondent were true facts. The worst affected villages are Ostia, Koilipur, and Brahmansahi. In this research paper qualitative as well as quantitative data has been statistically interpreted to obtain the most appropriate result about the present scenario of water issues of the coastal communities of Rajnagar block.*

Keywords : *Climate Variability; Community's Perception; Water Availability; Water Quality Assessment*

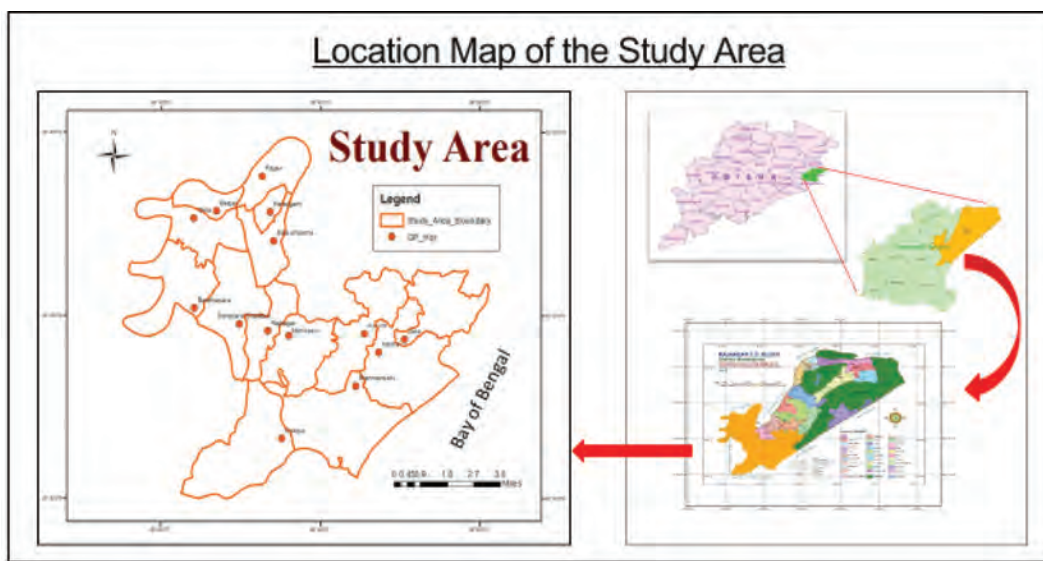
Introduction

Climate Change and its impact is a common phenomenon not only to any specific study area but also it is a threat to the whole world today. Climate change is expected to affect coastal communities around the world, many of which are already considered vulnerable to ongoing climatic variability (4th Assessment Report of Intergovernmental Panel on Climate Change (IPCCC), 2001).

The tremendous importance of water in human life necessitates the understanding of how any change in global climate could affect regional water availability. Thus, there is a necessity for understanding community perception about climate change and its linkage with existing water issues as they are common stakeholders suffering from the adverse effects of climate change.

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Kendrapara district, in the east coast of Odisha, is one of the worst victims of flood and is vulnerable to both excess of water during monsoon and deficit during pre-monsoon. As a consequence, this area is facing various kind of water resource related issues by which community livelihoods are getting affected. The study was undertaken at southern part of Rajnagar block of Kendrapara district of Odisha. Rajnagar Block is located along the western coast of Bay of Bengal. 14 Gram Panchayats have been selected to carry out the study. Rajnagar Block lies between $20^{\circ}30'5''$ to $20^{\circ}47'34''$ North latitudes and $86^{\circ}38'44''$ to $87^{\circ}5'36''$ East longitudes.



The main objective of this paper is to explore the community perception of climate change and to address climate change related water issues at the study area.

Methodology

Perceptions on climate variability of the community are a qualitative kind of research. It is necessary to get a complex, detailed understanding of the issue (Creswell, 2007). Responses have been obtained by the primary data collection of 85 randomly selected household of 37 villages under 14 gram panchayats in the southern part of Rajnagar block. The Response rate of the survey respondents was 100 percent and no respondent dropped out after starting questionnaire survey. Relevant climatic data like rainfall, temperature, natural calamities, that occurred in the area were obtained from the concerned departments such as Indian Meteorological Department and State Government reports of Odisha. Information about running tub wells and piped water supply has been collected from Rural Water Supply and Sanitation Department. Water sample was collected from 14 location during pre-monsoon period under 14 GPs for testing. Five parameters have been

selected for testing and samples have been tested in central water commission water quality laboratory eastern rivers division Bhubaneswar. The standards for drinking purposes recommended by IS 10500 (Indian Standards, 2012) have been considered.

Results and Discussion

Responses of Respondents

Most of the Respondents perceived that the changes in climate have occurred in last ten years. From the record of natural hazards it has been observed that Rajnagar block faced a lot of natural calamities especially flood over past as well as recent years (Table 2). Over 96 per cent of the total respondents reported that number of rainy days had drastically decreased during rainy season compared to ten years ago. They also reported that summers are getting hot as compared to previous years (Table 1). This indicates warmer air in summer which is causing faster evaporation resulting to dryness in soils. But intense rainfall with heavy downpours leads to more occurrence of flood. They identified climate change as a serious issue for their daily life, cultivation, health and overall livelihood. 31 per cent respondents found cyclone as a severe threat to their life (Table 3).

Table 1: Perceptions of Rainfall and Temperature Compared to Last Ten Years:

Climate Change Perception	Perception	Household	per cent
Duration (days) of Rainy Season decreased	Yes	82	96.47 per cent
	Maybe	2	2.35 per cent
	No	1	1.18 per cent
Duration (days) of Rainy Season decreased Total		85	100.00 per cent
Temp. Increased during Summer	Yes	82	96.47 per cent
	Maybe	1	1.18 per cent
	No	2	2.35 per cent
Temp. Increased during Summer Total		85	100.00 per cent

Source: Primary questionnaire survey of household, 2017

Survey respondents were also asked to report their overall perception of their concern about extreme climatic events induced diseases and health problems related to reduced water availability and Quality. 42 per cent of respondent perceived their concern about reduced water availability, health issues, Impacts on agricultural production as the adverse impact of climate change (Table 4).

Table 2: List of Related Extreme Climatic Events Occurred in The Study Area:

Type of Disaster	Year of Occurrence	Month of Occurrence
Flood	1992	August
	1999	October
	2001	July
	2003	July-August
	2006	August
	2008	September
	2009	September
	2011	August
Cyclone	1967	October
	1971	October
	1982	August
	1999	October
	2013	October
	2014	October
Heavy Rainfall	1995	May
Unseasonal Rain	2010	December

Source: Rajnagar Automatic Rain Recording Station

Table 3: Perceptions of Natural Hazard Scenario:

Natural Disaster	Low	per cent	Moderate	per cent	High	per cent	Severe	per cent	Grand Total	per cent
Cyclone	2	2	36	42	26	31	21	25	85	100
Flood	36	42	14	16	11	13	24	28	85	100
Tidal Surge	28	33	30	35	20	24	7	8	85	100

Source: Primary questionnaire survey of household, 2017

Table 4: Important Concerns of Respondents about Effects of Adverse Climate Impact

Important Concerns of Respondents about Effects of Adverse Climate Impact	H.H No.	per cent
Health issues	3	4
Health issues, Impacts on agricultural production	6	7
Health issues, Impacts on agricultural production, Rise in sea level	1	1
Impacts on agricultural production	1	1
Reduced water availability	2	2
Reduced water availability, Health issues	14	16
Reduced water availability, Health issues, Impacts on agricultural production	36	42
Reduced water availability, Health issues, Impacts on agricultural production, Increased no. of severe weather events	1	1
Reduced water availability, Health issues, Impacts on agricultural production, Rise in sea level	19	22
Reduced water availability, Health issues, Rise in sea level	1	1
Reduced water availability, Impacts on agricultural production, Rise in sea level	1	1
Grand Total	85	100

Source: Primary questionnaire survey of household, 2017

Water Quality Issues

The coastal community of Rajnagar block were living in a saline marshy tract along the coast. According to the directorate of Ground Water Survey& Investigation Bhubaneswar, Rajnagar block has full part of saline aquifers. Hence the ground water scenario being negative due to salinity and recent alteration of weather condition aggravates this situation because the upper layer of fresh water is dried up which causes salty and dilution water during summer. Most of the household uses tube well for drinking purpose but 33 per cent household reported that the water was not clean, 21 percent reported the water was salty (Table 5).

Water Quality Assessment:

Water is essential to sustain life and a satisfactory (adequate, safe and accessible) supply must be available for all (Guidelines for drinking-water Quality, 2004). According to the primary survey it has been noticed that community of the study area are being suffered from very low quality of water and it has been degraded by the frequent changes in climatic phenomena. For the general assessment of water quality to check suitability of water for drinking and domestic use of

Table 5: Household's Opinion on Tube Well Water Source

Household's Opinion	Count of Household No.	per cent
Difficult to access	10	12
Difficult to access, Salty	1	1
No problem	9	11
Not clean	28	33
Not clean, Difficult to access	12	14
Not clean, Difficult to access, Salty	5	6
Not clean, Salty	2	2
Salty	18	21
Grand Total	85	100

Source: Primary questionnaire survey of household, 2017

Table 6: General Water Parameters for Quality Assessment:

ID	Name of the GPs	Latitude (N)	Longitude (E)	Electronic Conductivity	TDS	Turbidity	pH	TH CaCo3Mg/l
1	Ostia	20°37'06.63"N	86°42'26.07"E	2970	1657	8.60	6.72	140.1
2	Keradgarh	20°37'47.12"N	86°43'10.55"E	1425	775	4.50	7.80	128.1
3	Rajpur	20°38'26.75"N	86°42'52.65"E	1250	676	3.70	7.25	157.7
4	Bandhapada	20°35'39.56"N	86°41'13.34"E	1313	711	4.10	7.18	228.2
5	Koilipur	20°31'22.71"N	86°42'42.92"E	2672	1486	6.90	7.20	168.1
6	Balisahipatna	20°37'10.48"N	86°42'48.74"E	1144	615	3.20	7.20	300.2
7	Hatina	20°32'38.97"N	86°47'10.80"E	1370	744	4.80	7.25	256.2
8	Rajnagar	20°34'33.47"N	86°43'07.10"E	1197	645	3.90	7.23	232.2
9	Kurunti	20°34'25.15"N	86°44'12.60"E	1060	568	2.90	7.30	248.2
10	Mahisasur	20°34'00.98"N	86°45'03.63"E	1030	551	2.60	7.80	148.1
11	Dera	20°34'53.56"N	86°49'14.39"E	1500	818	5.10	7.50	172.1
12	Brahmansahi	20°31'34.57"N	86°45'52.78"E	2995	1671	9.1	7.90	255.3
13	Sanabada Gopalpur	20°35'28.04"N	86°42'07.85"E	1254	678	3.2	7.33	165
14	Belpal	20°37'44.69"N	86°41'42.25"E	2159	1125	3.4	7.1	176

Source: Primary field survey, June, 2017

the area water quality testing has been done in this study. All water sample has been collected from shallow tube wells of 14 different site of respective gram panchayats. It has been taken during June 2017 were analysed for five general physical parameters and the test has been done in Central Water Commission, water quality laboratory, eastern rivers division Bhubaneswar.

All the parameters' permissible limits of drinking water are not same for different agencies i.e. USEPA, WHO, ISI. The table 7 shows the deferent tolerance limits of general drinking water parameters from which it can be observed the sample results. The result showing TDS and conductivity of three sites named Ostia, Koilipur and Brahmansahi has crossed the tolerance limit. It indicates higher salinity level in ground water. High levels of salt concentration in freshwater can cause problems for aquatic ecosystems and human uses.

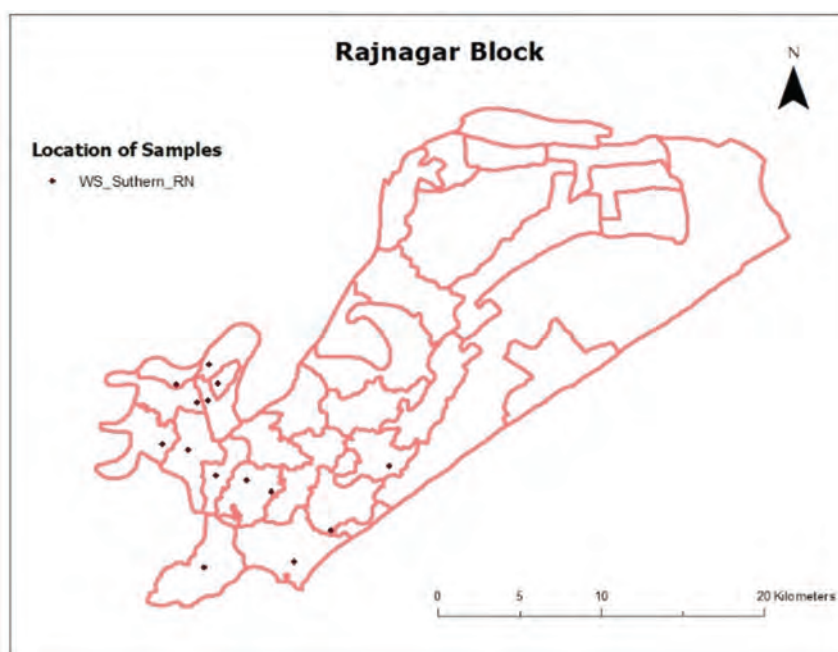


Table 7: Standards for Quality of Drinking Water:

Parameters	WHO	ISI Permissible (acceptable)
pH	6.5-8.5	6.5-8.5
EC	1400	-
TDS (mg/l)	1000	2000
Calcium (mg/L)	200	200 (75)
Magnesium (mg/L)	50	100 (30)

Findings and Conclusion

From this study it has been observed that 82 per cent of the respondent of the study area believe that number of rainy days decreased during rainy season and likewise they also think that the temperature has increased during summer because of which they are suffering from different sets of problem like water issues (deficiency of water, low water quality) and also crop loss and change in biodiversity. According to 42 per cent of the respondent the effects of adverse climate impact lies upon 'reduced water availability, health issues and impact on agricultural production' and 22 per cent of the respondent believe it also causes rise in sea level. This also leads to salt water intrusion which further creates loss in crop production and increase salinity of the water. After getting the water samples and making a quality assessment it has been found that the views of the respondent were true facts. The worst affected villages are Ostia, Koilipur, and Brahmansahi.

Still there is one question would be arisen with respect to the Community perception on climate variability and related water issues that, "which information is relevant for the related study?" Often a stakeholder's perception is based on rather hypothetical issues. Sometimes many stakeholders with different opinions and perceptions are difficult to handle. But it is also be rational to trust in local knowledge and individual experience rather than in science to address the climate change effects in a particular region to raise awareness and to increase the quality of decision making process. When involving perceptions of local respondents, they often come up with some unique strategies, measures, and points of action. However, this study concludes that the use of available information of human perception on climate change and water issues will allow researchers and policy makers to design and implement appropriate adaptation strategies for vulnerable areas affected from climate change.

Acknowledgement

This research was supported by DST/INSPIRE Fellowship under INSPIRE Program, Government of India, Ministry of Science & Technology, Department of Science & Technology. I convey my sincere gratitude to Prof. Kabir Mohan Sethy, research supervisor, Utkal University, under whose guidance this part of research has been completed. My sincere thanks also go to Anamika Choudhury and Alokya Kanungo for her invaluable assistance during the field work.

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Profile of Crime against Women in India: 2001-2016

Ritwika Mitra^{1*} and Joydeep Saha²

Abstract : Principles of gender bias in any country play a major role in the socio-economic and cultural matrix. In an emerging country like India, crimes against women pose serious questions on gender development. Crimes against women include gang rape, rape, molestation at the workplace, dowry death, foeticide, abatement to commit suicide and so on. Using the annual database published by National Crime Records Bureau, this paper attempts to discuss the spatio-temporal trends, patterns and types of crimes against women over the year 2001-2016. It finds that over the years, the crime rates have almost tripled, but since 2013, conviction rates have declined. Less developed states like Uttar Pradesh and Madhya Pradesh and moderately developed states like West Bengal have reported higher incidences of crimes.

Keywords : Cruelty, Patriarchy, Rape, Conviction, Domestic Violence

Introduction

Crimes against women are quite frequent in India. In this emerging era of media coverage – print, electronic and social – incidences of brutal crimes often become a serious point of discussion. India, a booming economy, represents wide socio-cultural diversity and large-scale variations in levels of development. Even if India's economic growth rates are higher, signs of inequality and impoverishment lead one to look at socio-cultural roots to explain how crimes against women vary or are it due to spatial and temporal inequalities in terms of development.

Objective

- To examine the trends of crime rate and conviction rate across years;
- To look at the trends of types of crimes against women;
- To study the spatial patterns of crimes against women.

Methodology

The analysis has been attempted at two levels, i.e. firstly it considers the temporal rate of crime against women, as well as conviction rate. Secondly, it looks at spatial patterns emerging at

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the state level. To show the rate of crimes against women in India, Crime Rate is calculated by NCRB as follows -

$$\text{Crime Rate} = (\text{Number of crimes recorded} / \text{total population}) * 100000$$

For the purpose of this study, across each state, average crime rate against women is calculated, for the 16-year time period of 2001-2016:

$$\text{Average Crime Rate per year} = (\text{Total rate of crimes for the time period} / \text{Number of years})$$

To address the broad objective of this paper, recent data on crime has been collected from the annual database titled as 'Crime in India', published by National Crime Records Bureau (NCRB), for the time period of 2001-2016. Content analysis of several crime reports published by some newspapers has also been done. However, certain limitation of data availability has restricted the study of crime at the macro level (i.e. state). In addition, the data on conviction rates pertaining to every single year is not available.

Illustration

The first section consists of an overview of trends of crime against women in 2001 to 2016, along with the conviction rates. In the second section, the trends of crime types have been analyzed. In the third section, a brief overview of state-level patterns is discussed.

Trends of Crime against Women

According to the NCRB, a crime against women is recorded in every three minutes. In India, two-three women are getting raped in every hour and every six hours women commit suicide due to injustice. Considering the criminal records it can be seen that the number of recorded criminal cases against women has tripled from 2001 to 2016. Besides, the numbers of arrested people have also increased. There are two probable reasons behind it – due to unemployment or other reasons, crimes are increasing and secondly, the numbers of reported crimes are increasing because people are becoming aware and getting opportunities to interact with police/legal advisors and register cases.

As an old saying goes “Justice delayed is justice denied”, therefore, this table also makes a comparative assessment of conviction rate. It is observed that from 2001 to 2012, conviction rates are higher than crime rates. However, since 2013, this trend is reversed. It points out to a possible fact that while growing legal awareness is influencing women to register cases, a serious shortage of police personnel coupled with long pending cases due to lack of shreds of evidence is delaying the disbursement of such cases, and hence, conviction rates are getting slower. As per the Bureau of Police Research and Development (BPRD), 2016, the actual police-population ratio is only 137 against a sanctioned strength of 181, thereby reflecting a shortfall of 24 percent police personnel. It should also be noted that the sanctioned strength is also quite lower than the UN-recommended standard police-population ratio of 222 (NITI Aayog, n.d.).

Table 1: Crime Rates and Conviction Rates, 2001-2016

Year	No. of Crimes Recorded	Total Population (in '000)	Crime Rate	Conviction Rate
2001	143795	1029991	13.96	NA
2002	143034	1045845	13.67	NA
2003	140601	1049700	13.39	NA
2004	154333	1065071	14.49	NA
2005	155553	1080264	14.39	33.93
2006	164765	1095352	15.04	32.70
2007	185312	1129866	16.40	28.30
2008	195857	1147996	17.06	31.03
2009	203804	1166079	17.47	27.80
2010	213585	1173108	18.20	27.80
2011	228650	1189173	19.22	26.90
2012	244270	1205074	20.27	21.30
2013	309546	1220800	25.35	21.70
2014	337922	1236345	27.33	18.90
2015	327394	1309100	25.01	21.70
2016	497482	1324200	37.57	18.90

Source: Calculated and Compiled from 'Crime in India', National Crime Records Bureau, 2001-2016; Census of India, 2001 and 2011

Types of Crime against Women

Girls are prey to crime (i.e. feticide) before they are born, some of them do not get proper opportunities as boys live, some of them compelled to marry at the early age before their physical and mental growth. Many types of crimes happen against women (Himabindu *et al*, 2014), like rape (by known and unknown people), attempt to commit rape, kidnapping and abduction of women, dowry death, assault on women with intent to outrage her modesty, insult to the modesty of women, cruelty by husband or relatives. Rape cases in India received extensive media coverage after a fatal gang rape happened in the capital of India, Delhi on December 2012 (Indian Express) and a village gang rape of a young girl in Jammu & Kashmir in 2018 (Times of India). It is analyzed that from 2001 to 2015, on an average, rape constitutes around 5.7 percent of total crimes against women. However, in 2016, this value has sharply jumped to 12 percent.

Domestic violence is another serious violation of all basic rights that a woman suffer in her own home at the hands of family members. In India where near about half of the population is female (sex ratio of 940 females per 1000 males according to Indian Census 2011) but they have always been deprived in the society and they considered physically and mentally weaker than a male and so tortured brutally. Sometimes it is just because of dowry, illiteracy, son preference, patriarchy and so on. From 2001 to 2012, cruelty by husband or relatives has increased from 40 to 53 percent of total crimes against women. However, with the enactment of domestic violence and growing awareness among people, such percentage has declined after 2012.

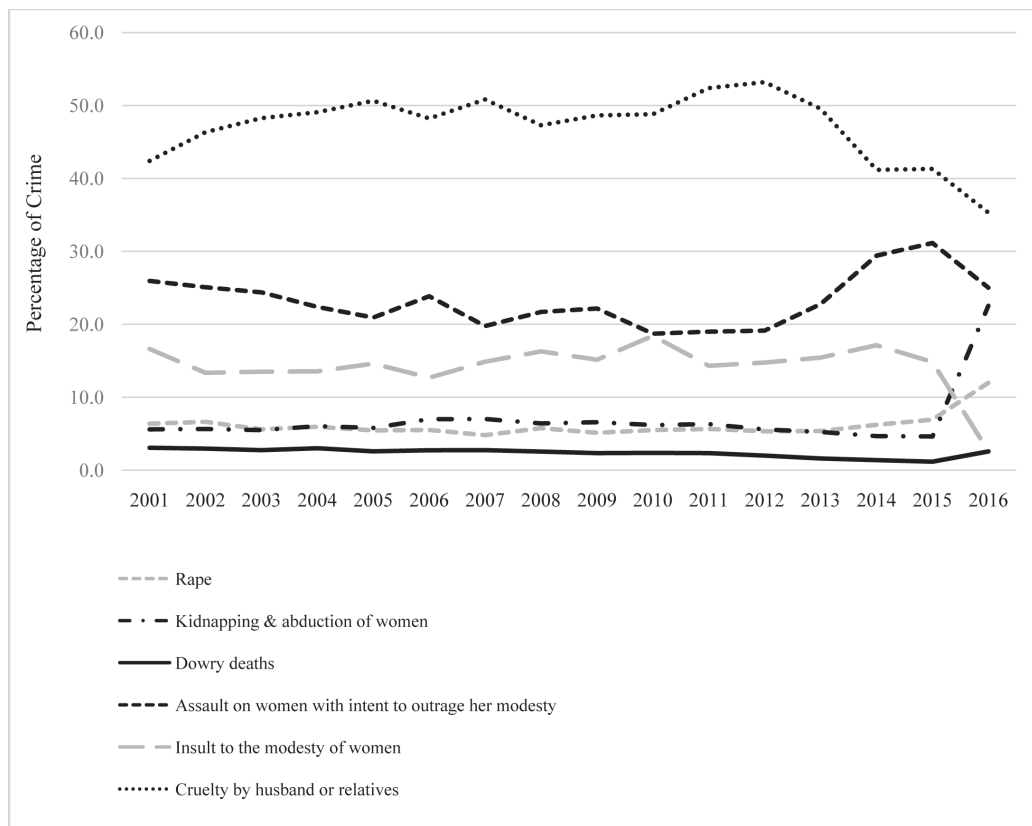


Fig. 1. Types of Crimes against Women, 2001-2016

Source: Drawn by Authors using the National Crime Records Bureau database

So far as modesty of women is considered, both the types of crimes - 'insult' and 'assault'- has been fluctuating in the given time period but has shown signs of decline in very recent years. The cause of concern is growing percentage of kidnapping and abduction of women – because it can lead to the proliferation of illegal prostitution.

Spatial Patterns

As per the state wise crime records against women were given by NCRB, in the year 2001 and 2002, Uttar Pradesh recorded the highest number of crimes whereas, in the year 2003, 2004 and 2005 Madhya Pradesh reported a massive number of crimes which has increased throughout this three years. Uttar Pradesh which had nearly shared 16.5 percent of country's population accounted 9.9 percent total crime against women in the year 2006 and it increased to 11.3 percent in 2007 and 12 percent in the year 2008 and ranked topmost on the data sheet. West Bengal which shares 7.6 percent of country's population, has enlisted 11.4 percent of crime against women in the year 2009 and even in the year 2010, 2011 and 2012, it holds 12.2 percent and 12.7 percent of total crimes against women. In the year 2013, 2014, 2015 Uttar Pradesh again listed as the highest number of crimes against women. Though, Delhi is the under of union territory but it is recorded the highest crime against women incidences in the year 2016 along with Madhya Pradesh and Uttar Pradesh. On the other hand, the north-eastern part of Indian Territory has always reported the lowest number of crimes but Assam shows the highest rate of crime against women according to population. This spatial pattern possibly leads one to comment that comparatively lower literacy rate, patriarchal social setting, and lawlessness are the main reasons behind the higher number of crimes in Uttar Pradesh and Madhya Pradesh. West Bengal's case seems different, as due to legal awareness, the higher number of crimes gets registered. In short, both less developed and moderately developed states report higher incidences of crimes.

The map (Fig.2) shows that states like Bihar, Mizoram, and Tamil Nadu, and Union Territories like Dadra-Nagar Haveli, Daman-Diu and Pondicherry reveal relatively lower average crime rate. Whereas, Delhi shows the relatively higher average crime rate. Assam also shows the higher rate of crime among the states of North-East India. It may be inferred that in states like Bihar and Uttar Pradesh (41.94 and 48.42 percent literacy rate, as per the Primary Census Abstract, Census of India, 2011) – having relatively lower female literacy rates – crimes against women remain unreported or underreported. However, in moderately or highly literate states like West Bengal (62.34 percent) and Kerala (83.04 percent), women related crimes get reported, and therefore, crime rates are on the higher side.

Major Findings

- In India, the crime rates against women has tripled in between 2001 and 2016.
- The number of arrested persons have also gone up.
- In between 2001 and 2012, the conviction rates related to the crimes against women are higher than the crime rates. However, from 2013 to 2016, this trend has reversed.
- In general, the types of crimes against women show a fluctuating trend in between 2001 and 2016. But, crimes like 'cruelty by husband or relatives', and 'insult to the modesty of women' have shown signs of decline. On the other hand, the crimes like 'rape' and 'kidnapping and abduction of women' have revealed signs of increase.

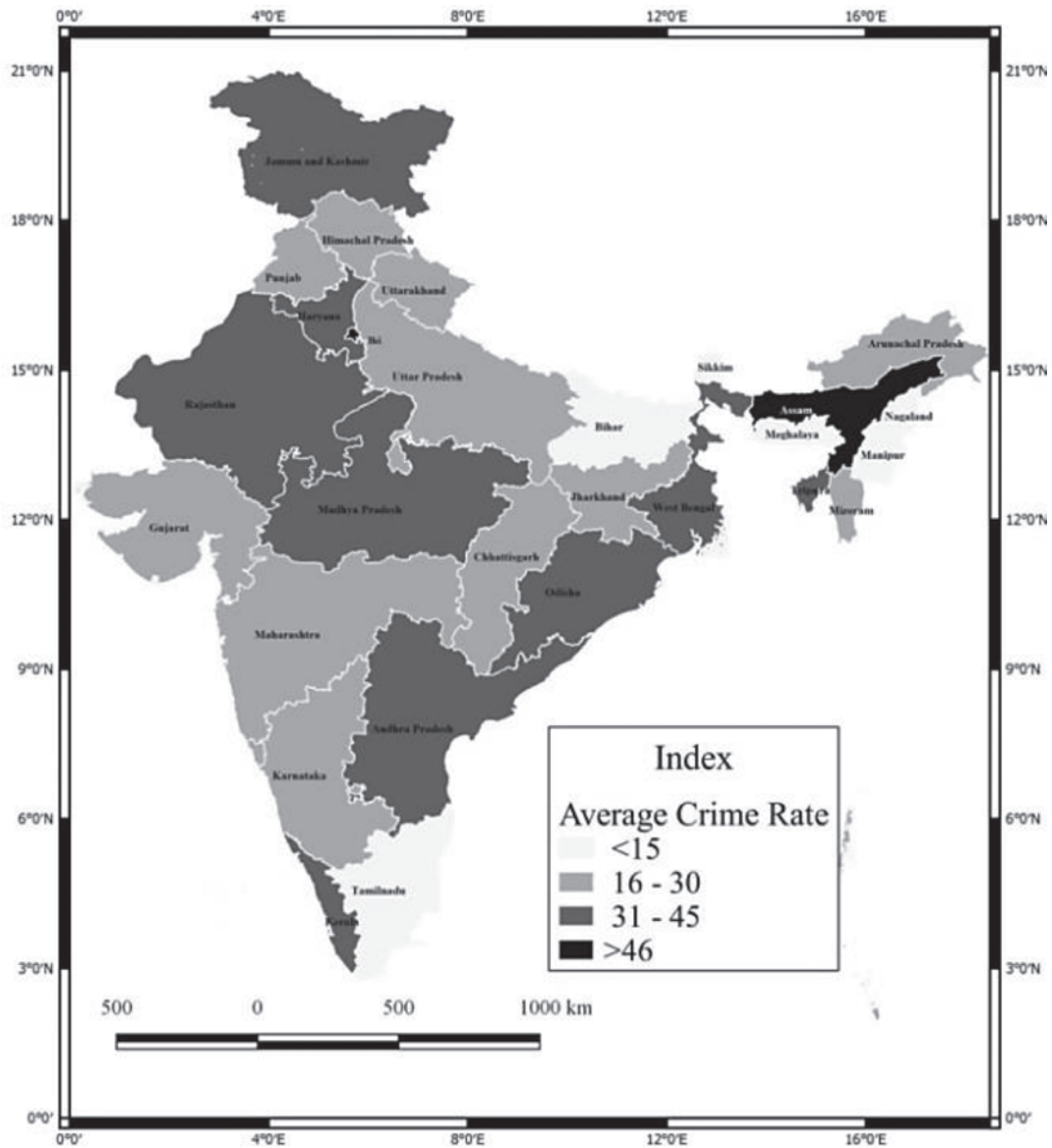


Fig. 2. Crime Rates against Women across States India 2001-2006

Source: National Crime Records Bureau Databases (2001-2016)

- Year wise spatial variations in terms of crimes against women vary. Such crimes, considering 16-year average figures, are found to be on a higher side in relatively less developed states like Uttar Pradesh, and Madhya Pradesh and moderately developed states like West Bengal. States like Bihar, Mizoram and Tamil Nadu report lower crime rates against women.

Conclusion

It can be summarized that the occurrence of crimes against women is a serious issue in India. Although a growing trend of reporting such crimes is getting stronger, many crimes remain unreported also. Not only the reporting but the conviction of criminals is also important from the viewpoint of law and order. Therefore, the Union Government and the State Governments should make adequate arrangement of police personnel and legal staff to address quick disbursal of reported crimes against women. Additionally, planned and sustained community-centric initiatives on women education and awareness camps (e.g. self-defense workshops; legal awareness camps) may help in gradual reduction of crimes against women in future.

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Status of Drinking Water in the Kolkata Municipal Corporation Area, India

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Abstract : *This paper aims to identify pure water or drinking water related issues in the city of Kolkata. The city has started to realize the stress as the demand for water is already outstripping the supply and per capita fresh water availability continues to be declined. In spite of having sufficient supply of potable water, as the Municipal authority claims, there are pockets in eastern, southern and western parts where supplied water doesn't suffice the need and people compel to depend on ground water or bottled water companies. The actual gap between demand and supply is huge as the amount of unaccounted-for water or transmission loss is more than 35 per cent. Hence majority of its residents use private or public tube wells to supplement their daily water needs in spite of having municipal water supply. Many pockets especially in southern part where industrial and real estate development has been rampant over the past few decades, pure water scarcity is a common problem. Specialist says that 90 per cent high-rises of the city use ground water due to lack of dedicated pipelines, resulting marked decline in the ground water level. Over extraction and insufficient recharge have enhanced the scope for ground water contamination by metallic elements like arsenic, iron etc. Besides that due to lack of awareness, people waste huge amount of purified water due to their ignorance. Thus the importance of effective management of water in Kolkata cannot be overemphasized. Lastly some micro level observations and measures for sustainable management of purified water are mentioned here.*

Keywords : Water stress, Water scarcity, Demand-Supply gap, Unaccounted for Water, Groundwater depletion, Sustainable management

Introduction

As per eminent Greek philosopher Pindar, water as best of all things, is the elixir of life (Hooja, Arora, Parnami, 2007). Access to safe drinking-water is essential to health, a basic human right and a component of effective policy for health protection (WHO, 2011). But as an impact of rapid population growth, rural to urban migration, rising wealth and resource consumption fresh water resources are getting scarce almost all over the world and hence it is crucial to conserve and control. Article 25 of the Universal Declaration of Human Right, 1948 says that water is the single most important element needed to achieve the universal human right to a standard of living adequate for health and wellbeing of himself and his family (PHED, 2011). According to World Water Council more than 1.2 billion people in the world do not have access to water and among those who have

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access to drinking water, only a small proportion seems to be enjoying continuous organized water supply through taps for 24 hours a day (PHED, 2011).

India has more than 18 per cent of the world's population with 4 per cent of the world's renewable water resources on 2.4 per cent of the world's land area (NWP, 2012). Amount of utilizable water are further skewed depending on various spatio-temporal factors like flood, drought and as a rising impact of climatic change. With an estimated per capita availability of 1588 cu m/capita/year (Central Water and Power Commission, 2010) India does not fall under the category of a water scarce country rather it can be termed as a country under 'water stress' because according to United Nations, if the annual water supply drops below 1700cu m per person, an area experiences water stress situation. While the annual water supply falls below 1000cu m per person, it generates water scarcity (UNICEF, 2013). WHO-UNICEF data shows that on 2008 about 96 per cent of the urban population and 84 per cent of the rural population had access to improved water sources. But this data does not confirm equity and adequacy in the distribution system. Moreover per capita availability was not as per norms in many areas. (UNICEF, FAO and SaciWATERs, 2013). As per NWP, 2012 large parts of India has already become water stressed depending on rapid growth in demand due to population growth, urbanization and changing lifestyles. The urban population of India is now 377106125, which is 31.15 per cent of the total population. In 2001 it was 27.81 per cent. Report of the High Power Expert Committee, 2011 on urbanization states that such a huge increment in percentage share of urban population could potentially cross 40 per cent by 2030 with over 200 million getting added to urban population during this period. This will create a progressively increasing gap in service delivery. Urban water supply is one of them.

At present fresh water or drinking water security is emerging as an increasingly important and vital issue for India. Many Indian cities have started to experience moderate to severe water shortages, brought on by the real-time effects of agricultural growth, industrialization and urbanization.

Table 1: Households by Main Source of Drinking Water

	Tap water from treated source per cent	Tap water from untreated source per cent	Hand pump/ tubewell/ borehole per cent	Covered well per cent	Uncovered well per cent	Others (spring/river/ canal) per cent
India	62.0	8.6	20.75	1.65	4.5	2.5
West Bengal	49.96	5.66	38.29	0.89	3.64	1.57
Kolkata (KMC)	84.89	3.21	9.91	0.26	0.18	1.55

Source: Census of India, 2011

Though a large portion of urban India use piped water as a principal source of drinking water high degree of inequality prevails in the distribution system. Too much excavation of ground water has resulted in depletion of sub-terrain water resource. The number of water stressed regions at

various parts of our country is increasing at an alarming rate due to rapid growth of real estate. The rapid urban growth leads to escalation of water demand. In terms of water shortage, West Bengal faces lesser problem as compared with other places of India (WBPCB, 2004). The state has 7.5 per cent of the water resource of the country which is getting scarce increasingly with unrestrained increase in population, expansion of irrigation network and developmental needs (Rudra, 2009). The availability of water resource in this state is spatially and temporally uneven. The average annual rainfall in West Bengal is about 1750mm, which is considerably high. But excessive misuse or abuse (in the consumer end and during transmission) generates water crisis within the state. Over extraction of ground water has resulted in arsenic contamination of subsurface water in different administrative blocks of South Bengal. Fluoride poisoning has also took place in western part of Bengal. Around 26million people are currently at danger and even the city of Kolkata is not out of this arsenic menace (Rudra, 2009).

In Kolkata, the problem regarding the availability of drinking water is gradually becoming severe. Despite its ecologically favorable location along the east bank of the river Hugli the city is increasingly running out of fresh water. About half the population that live in the slums and the squatter settlements collect water from stand-posts. The rest of the slum population do not have access to municipal water supply and have to make their own arrangements (UN-HABITAT, 2005). Its wetland, a vast biological natural cleaning system is now being crammed up for urban growth. Kolkata's ground water is now more and more over exploited and polluted.

The Study Area

Kolkata Municipal Corporation (KMC) has a total area of about 187.33 sq. km with 4486679 population as per Census of India, 2011. River Hugli lies on its north western part. On the south and south-western part there is South 24-Paragana district whereas North 24-Paragana district and Salt Lake lie on its northern and eastern margin respectively. It extends from 22°28' N – 22°37'30" N latitude and from 88°17'30" E - 88°25' E longitude. The region is divided into 141 wards and 15 number of borough. KMC is located in the lower part of the Ganga basin.

Database and Methodology

The study has been done mainly based on secondary sources of data along with observation of the researchers, relevant existing literatures available in the form of research articles, published Government reports, books etc. Water supply being a civic concern authorities of the Water Supply Department, KMC were approached for the purpose of collecting data. The data thus obtained have been assessed qualitatively to depict the ground reality on availability of potable drinking water supply.

Objectives

- To estimate the demand supply scenario in KMC area.
- To understand the extent of different problems regarding the quantity and quality of supplied piped water.

- To highlight the status of ground water in different parts of KMC as per information published in Government reports, articles by different researchers.
- To trace the possible ways to overcome these problems.

Problem of the Study Area

In terms of water scarcity, the city of Kolkata is less affected. Kolkata is a city gifted with considerable water resources. River Ganga is the principal source of surface water for the city. It has good ground water reserves too. The average annual rainfall in Kolkata is about 1647mm (KMC, 2007) which is considerably high. But with increasing demand on assured water availability and continuous degradation of surface water bodies, dependence on ground water has increased to large extent. Unplanned and uncontrolled extraction of ground water leads to a falling trend of ground water level in Kolkata. The United Nations Environment programme (UNEP) has enlisted Kolkata among the twelve megacities increasingly becoming dependent on groundwater (WBPCB, 2004).

Demand, supply Status and Associated Problems

The Kolkata Municipal Corporation area, at present, is mostly having water supply based on surface water supplemented with ground water. The water supply system in Kolkata Municipal Corporation area is rested upon a number of technical structures, running simultaneously- like water treatment plants, overhead reservoirs, booster pumping stations etc. to provide purified piped water throughout the city. Currently there are five Water Treatment Plants and more or less eighteen booster pumping stations at KMC area. Names and capacity of these WTPs are given in the table below:-

Table 2: Existing Water Treatment Plants (WTP)

Name of WTP	Capacity in Million Gallon/Day (MGD)	Present Generation in Million Gallon /Day (MGD)	Served area
Indira Gandhi Water Treatment Plant, Palta (began operation from 1869)	260	210	North Kolkata
Garden Reach Water Works (started operation from 1985)	185	143	South Kolkata
Jorabagan WTP (production started from Jnuary,2006)	8	5	Jorabagan, Burrabazar
Watgunge WTP (production Khidderpore)	5	3.5	Watgunge,
Jai Hind Jal Prkalpa, Dhapa, (operation started from December,2014)	30	20	E.M.Bypass, Rajarhat

Source: Kolkata Municipal Corporation, 2016

Besides that there are 325 power driven deep tube wells (with a capacity of 25.35 million gallon per day) and more than 10000 hand driven tube wells throughout the city as per information provided by Water Supply Department, KMC, 2016. According to the Water Supply Department, KMC, on 2012 the demand was around 293 million gallon per day and supply from surface and ground water source was about 271 MGD and 25 MGD respectively.

Table 3: Demand and Supply of Treated Water in KMC

Year	Population	Domestic Demand (in million gallon per day)	Total Demand (in million gallon per day)	Capacity of Supplied Surface water (in million gallon per day)
2011	4486679	148.24	257.13	268.5
2012	4845961	160.11	274.88	298.5
2013	4892573	161.65	277.18	298.5
2014	4939633	163.20	279.51	338.5
2015	4987146	164.77	281.86	357.0
2016	5035116	166.36	284.22	383.0

N.B: Population data from 2012 to 2016 has been processed by the author through population projection by Least Square Method

N.B: Demand and supply data are calculated by the author, on the basis of information provided by Water supply Department, KMC, 2016

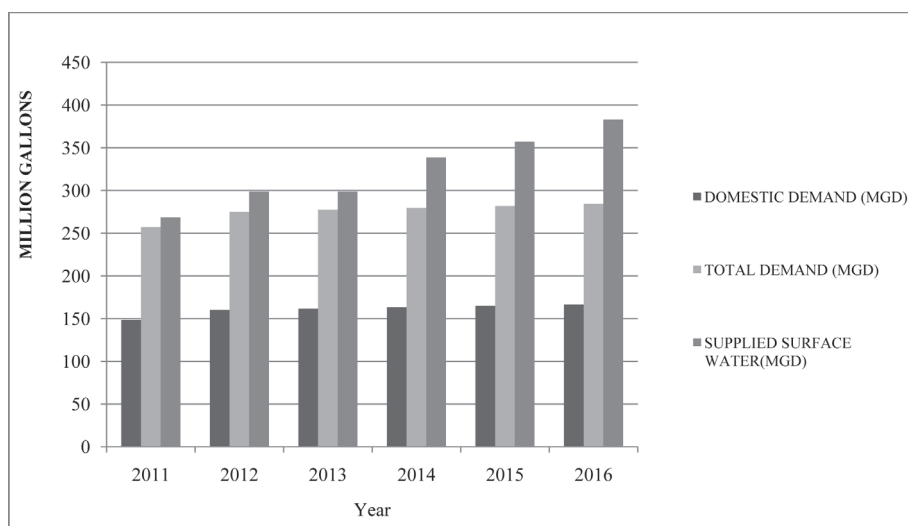


Fig: 1 Demand Supply Scenario of KMC

From the above diagram it has been clearly shown that, officially there is always an excess of supply over demand. But wastage by one person denies water to other person in reality. Till now there are many areas, where rapid urbanization and resultant infrastructure development works along with construction of multistoried buildings are carried on, supplied water is not enough to meet the needs of the people and they are compelled to use groundwater for their drinking and other domestic purposes. Though official figure states that Kolkata would be able to manage this hike comfortably but in reality the situation is different. Wastage at consumer end is the biggest drawback of the system. World Bank Study reported that the amount of unaccounted for water (UFW) is around 35 per cent (Maity, 2012). UFW is the water that is produced and is lost before it reaches to the customer. As a result in spite of being a water surplus city it has become a water-shortage city. The different reasons behind this are as follows:

- The main network for drinking water in Kolkata is more than hundred years old and was built during the British Rule. As a result it has been worn out during passage of time. The quality of water leaving the plants and pumping stations is potable, but it gets contaminated by fiscal bacteria in its long journey to the consumers. The cheap and inferior quality of distribution pipes often results in massive leakage due to increased water pressure. Bursting of pipes is frequent due to minor or major leakages.
- Overflowing of water from stand posts, reservoirs hours after hours are another major cause of treated water deficiency. Besides that there are many pockets in the eastern and southern fringe of Kolkata that have no pipelines at all, to avail the treated surface water. KMC officials claim that 82.70 per cent of the total households is served by the surface water while 10 per cent of the household covered by ground water (Maity, 2012). Though there is no apparent dearth of water, the city lacks resources to treat the water or maintain and manage the distribution system.

Ground water problems and issues

The depth of ground water level at Kolkata ranges from 10.92 to 19.83 mbgl during pre-monsoon months and 8.08 to 17.74 mbgl during post monsoon period. In major parts of the city the level generally fluctuates between 14.50-16.50 mbgl owing to huge withdrawal of ground water for domestic and industrial purposes (CGWB, 2013-14).

Rampant use of tube-wells and unscientific withdrawal has led to a noticeable drop in ground water levels in KMC area. According to a report published by Central Ground Water Board, 2014 there is a fall of 14 meter in ground water level in last 55 years in Kolkata from 1958 to 2013 and the declining trend of water level is 0.49 meter/year at the core of the trough while at the periphery it is 0.21 meter/year (ABP, 12th April, 2014). As a result polluted water from all directions is entering in this depression. Besides that continuous over drafting of the aquifer results in decrease of pore-water pressure in the aquifer and a sequential increase of the effective stress in the soil and the resultant consolidation of the soil and land subsidence. In a study conducted by the School of Environmental Studies and later by State Water Investigation Directorate, it has been proved that

ground water of this city is contaminated by arsenic, iron cadmium and many other heavy metals. Despite, a large portion of the supplied water are being lifted from 417 numbers of deep tube wells (ABP, 14th March, 2015). In addition private tankers are also supplying the same ground water to establishments in and around the city. There is no estimation of their numbers.

Excessive withdrawal of ground water resulted in noticeable changes in hydrological quality of ground water in Kolkata. According to a report, the city is sitting on an arsenic volcano as per research work carried out by the School of Environmental Studies, Jadavpur University. They have conducted over 50,000 arsenic tests in Kolkata and proved that a large section of the city tube wells contain arsenic contaminated water and the southern part of the city is more contaminated than the northern and central parts (Ghosh, 2013). The desirable limit of arsenic in water according to Indian standards is 0.01 mg/l while the permissible limit is 0.05mg/l. Arsenic contaminated drinking water can cause increased pigmentation, peripheral neuropathy, skin cancer, bladder and lung cancers, peripheral vascular disease and various other complications (WHO, 2011).

It has been detected that the places of Kolkata where arsenic concentration is high iron concentration is also very high above 10mg/liter (Ghosh, 2013). In the eastern part near Tangra, Topsia, Tiljala high concentration of toxic elements such as cadmium, copper, nickel are found in shallow aquifers within 20 meter below ground level. Ground water tapped by open wells in the marshes of Bullygunge, Tollygunge, Tiljala, Dhakuria Kasba, Santoshpur, Garia, Behala, Barisha, Thakurpukur area is bacteriologically polluted as they are hydraulically connected to the surface water bodies (KMC, 2007).

According to the head of KMC water department in some remote areas of south and east Kolkata the supply water from Gardenrich pumping station is not sufficient to fulfill the water requirement of the people. Hence the authorities are compelled to give permission to extract ground water.

Challenges in water supply among urban poor (some micro level observations)

In Kolkata 31.35 per cent of the city population lives in slums (Census of India, 2011) who have limited access to public sources, and very rare access to private ones. They usually collect drinking water either through a few stand posts or from tube wells.

Borough No.XIII, Ward No.122, South Kolkata

- In S.S.Dhawan colony except two or three families almost all the surveyed households have their own tap inside their premise (at a depth of two-three feet below the floor level).But due to poor/insufficient supply they are compelled to use public taps standing in queue. There are four public taps, two tube wells and one pond in the locality. Tube wells are less used for drinking purpose due to high iron content and foul smell.
- In Mollah Para community tap water is the only source of drinking water. There are five taps in the locality. Hence population pressure on individual tap is very high. In rainy season due to water logging of lanes and by lanes taps are inundated under brackish water

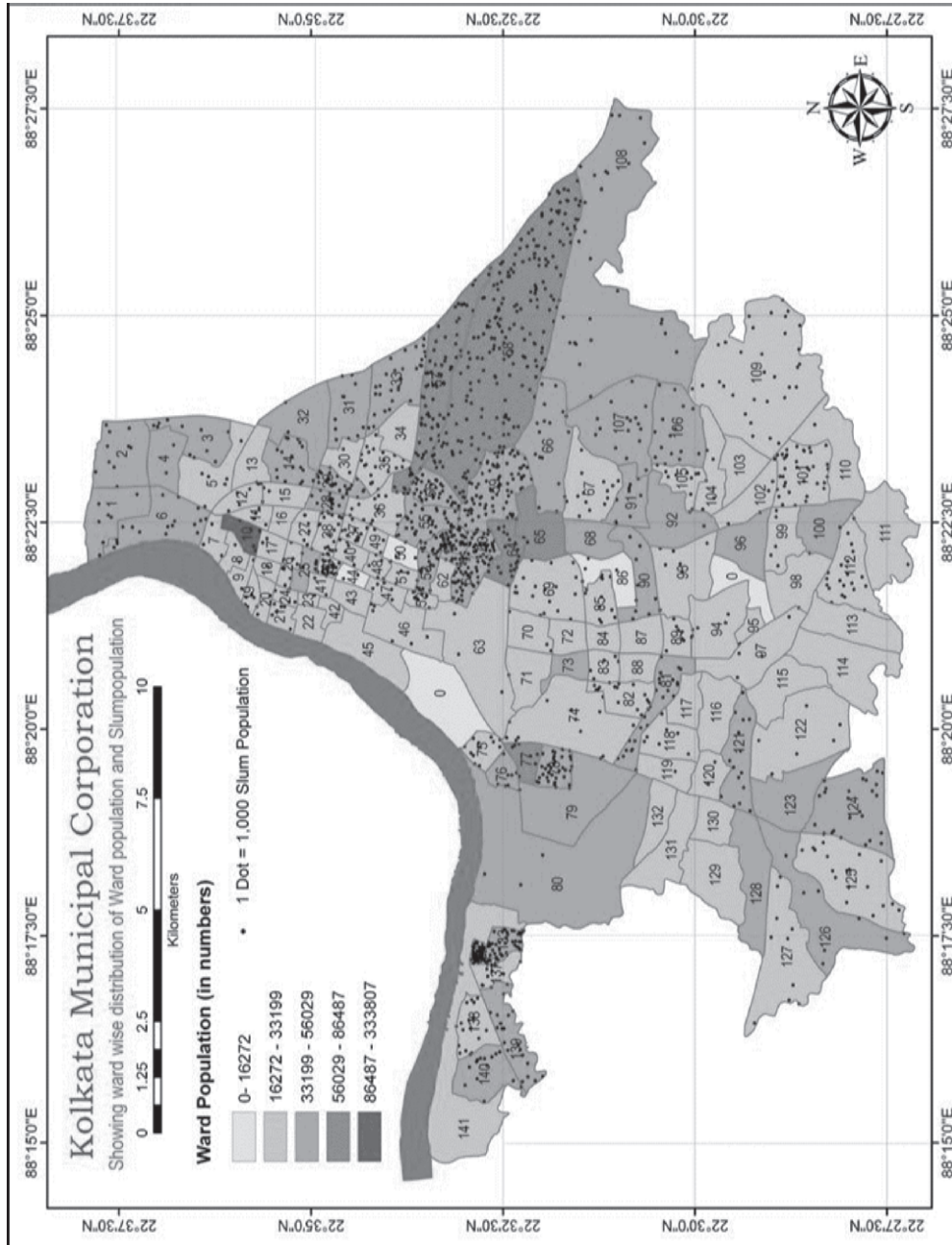


Fig: 2 Location of the surveyed wards

Source: Kolkata Municipal Corporation, 2011

and make the situation pathetic. Tubewells and pond water are used for other domestic usage.

- Despite of having corporation made ground water pump (which usually run after 12 noon onwards) scarcity of drinking water persists almost throughout the year in Doctor Bagan. Infact it falls miserable in summer when for a single bucket of water they have to wait for KMC water van or travel long distance (5-6 km) to fetch water. For other domestic uses all the households have their own covered well (usually 10 foot) in their premise.
- In Ishan Ghosh Road tube wells are more used than tap water because tap water is contaminated with high iron content, as per the information of local people. In 2010 drinking water mishap took place here; a large number of unwanted objects started to come out from corporation run tap water. This event have forced the dwellers to use tube well water for drinking purpose.

Borough No.VII, Ward No.58, South-East Kolkata

The dwellers in the Tangra Area usually suffer from extreme water scarcity. There is high risk of chromium contamination of surface and sub-surface water as the area is located in the leather complex area of Kolkata (CGWB, 2013-14). People informed that piped water supply is highly inadequate and erratic and rich in excessive iron content. Hence many people have dug wells in their premises.

Borough No.VII, Ward No.38, North Kolkata

The four places of Ward No 38 where observations are made are-

- 15, Biplabi Pulin Das Street,
- 29, Badurbagan Street,
- 121,123,147 Keshab Chandra Sen Street and
- 15, 16, 17 Balai Singha Lane

From the observations it has been found that almost 90 per cent residents use municipality run tap water for drinking purpose as ground water of this area is not at all suitable for drinking. Foul smell comes out from tube wells and dugwells. For other domestic uses they mostly depend on untreated Ganga water.

Measures for Sustainable Management

The drinking water problems are obviously more strident as they directly affect the human wellbeing. World Water Councils' World Water Vision (2000) points out that today's water crisis is not having too little water to satisfy our needs but it is a crisis of managing water so badly that billions of people and the environment suffer badly (Cosgrove and Rijsberman, 2000). The reality of pure water crisis cannot be ignored in KMC area. Kolkata has been infamous for being poor in its water resource management.

Demand Side Management

From 2005 onwards the KMC is continuously trying to augment piped water supply through commissioning of new water treatment plants, booster pumping stations, reservoirs, head works, sinking new tube wells in deficit areas. Though the expansion of supply is important but it may not be sustainable in the long run. In short run also, excavation of tube wells in the deficit zones may prove fatal for human health due to quantity and quality problems. Hence we should look into the demand side of planning. To do this, water meter has to be installed at the household level to curb the misuse and overuse of water and priority should be given on low water intensive devices.

Other Measures

In Kolkata the amount of water loss through leakage, tap or reservoir overflowing, theft of water and illegal connections is more than 35 per cent (Maity, 2012), while the acceptable level is about 15 per cent according to CPHEEO 1999 Norms. This huge amount of wastage should be stopped by implementing strict rules and regulations. First of all amount of actual losses of water should be confirmed by proper meter reading at the origin and consumer end. Then proper measures like refurbishment of the old pipelines to reduce the amount of leakage have to be applied to reduce the quantity of transmission loss. Emphasis should be given on the equal distribution of water that is 150 liter per capita per day as per CPHEEO, 1999 Norms by extending pipelines in every nook and corner of the city. Special care should be given to the extension of piped water connection to slum areas of the city. Augmentation of ground water through artificial recharge should be implemented in multistoried buildings. Regulation of over use of ground water through administrative and legal measures should be done. Minimization of wastage of water at the consumer end by making people conscious about the negative effect of water loss in future should be encouraged.

Rain water harvesting should be made mandatory for all the high-rises, multistoried buildings. The total amount of rainfall in KMC area is 1647mm which can be utilized by conservation and artificial recharge. Schools and colleges are also be encouraged to use their underground reservoirs to store water or to use it for various purposes other than drinking.

Conclusion

The analyses of the data reveal that in Kolkata municipal Corporation area the availability of good quality drinking water is not adequate as the supply is low and insufficient and it becomes clear that fresh water shortages are expected to aggravate in the coming years as the development of fresh water resources is not in pace with increasing needs and developmental activities. So to make the available purified water sustainable each and every person has to use water judiciously. Collective responsibility is the only way to achieve this. Government should make observing committees so that the amount of water loss can be checked rigorously.

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Food Security and Gender Disparity in West Bengal: A Cross-sectional Analysis

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Abstract : Food security is a global issue which come ahead in the time of 1970s, which is not only the ethical and moral topic but more importantly is a right based issue which deals with the relation of the natural-cultural ecology with food and nutrition in different dimensions. Major objective of this paper is to make an outline the district wise overall study of food security and gender dimension in food and nutrition security in West Bengal. People's overall access to food relies to a great extent on the work of rural women. Women comprise, in average, 43 percent of the agricultural labour force in developing countries (FAO, 2011). West Bengal is organized into 19 districts, 66 sub-division and 341 development blocks. This district level study based on the secondary data and point out the district level variations in the food security and explains these micro variations with reference to the logical reasons. To get the indexes of food security total 26 indicators (10 indicators for food availability, 6 for food accessibility, 3 for food utilization and 7 for food stability) have been selected after carefully examining their degree of importance in determining the regional patterns of food security in the study area. Food security pattern and female literacy pattern correlation is also discussed in this paper. The per capita food and nutrition availability is calculated with reference to different crops that point out the share of different crops in the food security for the people's diet diversity. The highest food security has been recorded in Bardhaman district and lowest in Dakshin Dinajpur district and highest below normal Body Mass Index (BMI) found in Darjiling and Puruliya district and lowest in Hugli. Highest gender gap of below normal BMI basically found in those districts because of low literacy, education facilities, and lack of health facilities.

Keywords : Gender Disparity, Food and Nutrition Security, Per capita availability and Regional patterns.

Introduction

Food security as a concept originated in the mid-1970s, in the discussions of international food problems during the time of global food crisis, mainly in global food conference which held at Rome, 1974. The initial focus of attention was primarily on food supply problems - of assuring the availability and to some degree the price stability of basic foodstuffs at the international and national level. Food security is a flexible concept as reflected in the many attempts at definition in research and policy usage. Even a decade ago, there were about 200 definitions in published

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writings. Food security simply defines the absence of hunger or to provide sufficient amount of food at the global, national, community or household level (Anderson, 2009). In other words food security exists when “no child, woman and man should go to the bed hungry and no human being’s physical and mental capabilities should be stunted by malnutrition” (Acharya, 1983; Mohammad, 1995). Food security is achieved “when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (FAO, 1996). To achieve such a situation requires concerted action at individual, household, national, regional, and global levels (FAO 1996). Experiences from India and other countries have shown that even when the national level food security is achieved, individuals and groups in the country can still go hungry because they do not have the means to access food (Clay, 1989). According to WHO, every year there are about 4 billion cases of water-and food-borne diarrheal diseases globally. These illnesses exacerbate problems of malnutrition and reportedly account for 1.8 million deaths annually. Unacceptable standards of food safety render food unfit for human consumption and thus impair food security and public health. Food safety and nutritional quality are essential elements and integral part of food security. Effective efforts to improve food security must occur in conjunction with efforts to improve nutrition security.

Food security is an importance context today as now human being have enough production as well as man power, knowledge and skill at the same point many people their life with low quality of food and calorie. If we properly distributed our enough technology, knowledge and production in every corner to every person with the help of science and think about our prospect on future generation then food will be secure. Foundation of food security built on four pillars. These are i) Food Availability ii) Food Accessibility iii) Food Utilization iv) Food Stability.

Food availability is defined as the sufficient quantities of food of appropriate quality, supplied through household production, other domestic output, and commercial inputs imports, including food assistance to all individuals within a country or a spatial unit. Food access is ensured when all households and individuals within them have enough resources to obtain food in sufficient quantity, quality and diversity for a nutritious diet. Food utilization is the proper biological use of food, requiring a diet providing sufficient energy and essential nutritious potable water, knowledge, habits and adequate sanitation. To be food secure, a population, household or individual must have access to adequate food at all times. They should not risk losing access to food as a consequence of sudden shocks (FAO, 2006).

Research Objectives of the Study

The following objectives have been taken in to consideration for the study:

1. To examine the status of the food and nutrition security in the West Bengal and also measure the intra- district difference in the food security pattern in study area.
2. To make an outline the district wise overall study of food security and gender dimension in West Bengal.

The Study Area

The state West Bengal has been selected as a study area to demonstrate a picturesque of food security. The state is situated between 21°31' & 27°13'14" North Latitudes and 85°45'20" & 89°53' east Longitudes. West Bengal is a small state of unique landscape having variety of relief features. The mountain ranges in the north, plateau in the west, broad plain in the center and the coastal deltaic region in the south. This covers 88,752 square kilometers and accounts for 2.7 percent of total area of the India, while its share in country's population is 16.2 percent. West Bengal is organized into 19 districts, 66 sub-division and 341 development blocks. There are 3351 Gram *panchayats* in the State covering 40782 inhabited villages. In this study capital of West Bengal (Kolkata) is not include as the district level analyses food security means total 18 district has been selected.

Data Base and Methodology

The study is basically based on secondary data which has been collected mainly from published works and reports namely Census of India, Govt. of India, New Delhi, West Bengal State Statistical Hand Book 2001-2002, 2007-08, 2008-09, 2010-11 and 2011- 2012, Bureau of Applied Economics and Statistics, Government of West Bengal. Gender discrimination in the sense of food and nutrition security has been determined by National Family Health Survey-4 (NFHS-4) data (2015-2016). The district has been taken as unit of analysis. In order to get the indexes of food security the following 26 indicators (10 indicators for food availability, 6 for food accessibility, 3 for food utilization and 7 for food stability) have been selected after carefully examining their degree of importance in determining the food security and regional patterns of food security in the study area. Food security has categorized into five stages including very high, high, medium, low and very low. For analysing the data 'z score' or Standard Score Additive Model has been used to arrive at the general level of agricultural development and regional disparities food security for the districts of the state. This is very simple in calculation but is the most appropriate in its results. For the 'z score'

$$z = \frac{X - \bar{X}}{\delta}$$

Z = Standard score, X = Original Values of the score, $\bar{X}$ = Mean of variables, δ = Standard deviation of variables, the obtained Z=score of each indicator is added district wise and block wise to be known as composite Z = score(s) for each spatial unit of the study area. Finally $Cs = \frac{\sum Zij}{N}$

Cs denotes composite Z-scores, Zij indicates the sums of Z-scores of indicators j in district i and N is symbolize the number of variables.

The correlation coefficient is worked out among dependent variable (Food Security) and independent variables (factors of Food Availability, Food Accessibility, Food Utilization and Food

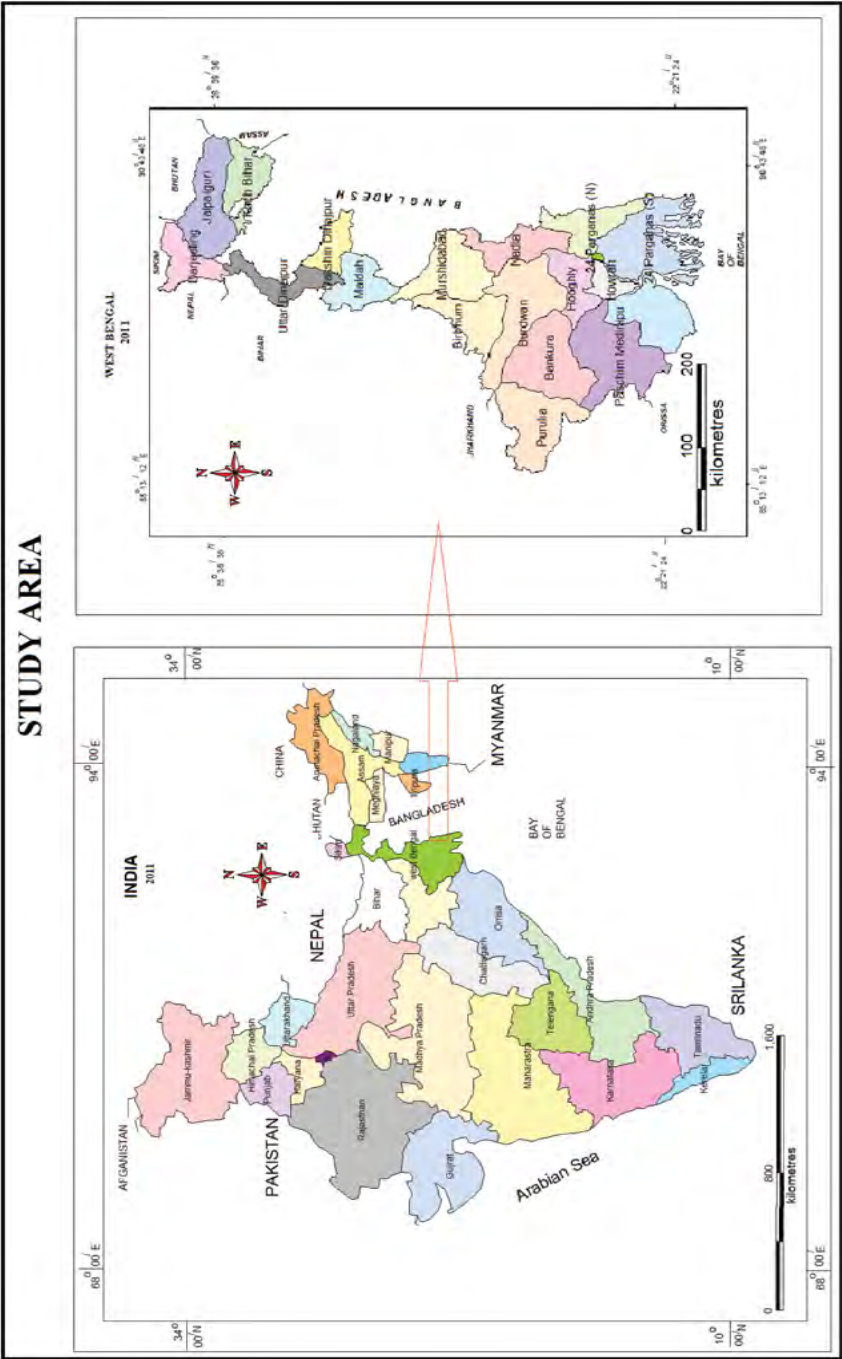


Fig. 1

Table 1: Selected indicator for the study

No.	Selected Indicators	Symbols
Food Availability		
1	Availability of cereals	X_1
2	Availability of pulses	X_2
3	Availability of Food grains	X_3
4	Calorie Availability of cereals	X_4
5	Calorie Availability of Pulses	X_5
6	Calorie Availability of total food grains	X_6
7	Livestock Availability	X_7
8	Cropping Intensity	X_8
9	Net sown area	X_9
10	Number of ration shop per 1000 of population	X_{10}
Food Accessibility		
11	Literacy rate	X_{11}
12	Percentage of worker to total population	X_{12}
13	Percentage of cultivator to total population	X_{13}
14	Number of market/hat per 1000 of population	X_{14}
15	Number of post office per lakh of population	X_{15}
16	Average population per bank office (000)	X_{16}
Food Utilization		
17	Number of hospital bed to total number of population	X_{17}
18	Number of family welfare Centre	X_{18}
19	Percentage of population cover under the water supply schemes	X_{19}
Food Stability		
20	Number of co-operative society per 1000 of cultivators	X_{20}
21	Cold storage capacity in Quintal	X_{21}
22	Number of bank to cultivator's ratio	X_{22}
23	Productivity of food grains	X_{23}
24	Productivity of Cash crops	X_{24}
25	Electrified village in Percentage	X_{25}
26	Length of Road in Km.	X_{26}

Stability) and student t-test technique is applied to find out the determinants which are significant at 1 per cent and 5 per cent levels, which is given below:

$$t = r \sqrt{\frac{(n-2)}{1-r^2}}$$

Where: t is the calculated value of t' in the test of significance, n is the number of observation, r is the computed value of co-efficient of correlation.

District wise Analysis of Food Security in the Study Area

Food security includes four major sub indicators namely, food availability (ten indicators), food accessibility (six indicators), food utilization (three indicators) and food stability (seven indicators).

Table 2: District wise distribution of food availability in the study area (z score)

Sl. No	Sl. No.	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	Composite z score
1	Bardhaman	0.308	-0.621	0.29	0.301	-0.621	0.284	1.45	0.153	1.737	0.284	0.357
2	Birbhum	1.625	1.036	1.651	1.621	1.035	1.647	0.565	-0.294	0.423	0.554	0.986
3	Bankura	1.257	-0.762	1.234	1.252	-0.762	1.23	0.431	-1.165	-0.131	1.405	0.399
4	Purba Medinipur	-0.015	-0.031	-0.016	-0.022	-0.031	-0.023	-0.378	-0.12	0.107	-0.851	-0.138
5	Paschim Medinipur	1.132	-0.578	1.115	1.127	-0.578	1.11	1.328	-0.344	2.071	0.219	0.660
6	Haora	-1.701	-0.676	-1.717	-1.71	-0.675	-1.726	-1.969	0.974	-1.962	-1.173	-1.234
7	Hugli	-0.594	-0.77	-0.614	-0.601	-0.77	-0.622	-0.72	1.422	-0.643	-0.657	-0.457
8	North 24-Parganas	-1.531	-0.401	-1.541	-1.54	-0.401	-1.549	1.301	-0.518	-0.538	-1.43	-0.815
9	South-24 Parganas	-0.979	-0.009	-0.978	-0.987	-0.009	-0.986	0.623	-0.941	0.804	-0.631	-0.409
10	Nadia	-0.339	3.114	-0.254	-0.218	3.114	-0.133	0.178	2.044	0.13	0.309	0.795
11	Murshidabad	-0.264	1.43	-0.225	-0.27	1.43	-0.231	1.723	1.521	1.177	-0.425	0.587
12	Uttar Dinajpur	1.073	-0.595	1.055	1.063	-0.595	1.046	-0.528	-0.394	-0.025	-0.606	0.149
13	Daksin Dinajpur	1.16	-0.712	1.14	1.156	-0.712	1.136	-0.795	0.327	-0.929	-0.567	0.120
14	Maldah	-0.062	1.07	-0.033	-0.069	1.07	-0.039	-0.281	0.477	-0.588	-0.438	0.111
15	Jalpaiguri	-0.65	-0.479	-0.663	-0.658	-0.479	-0.671	-0.395	-0.344	0.564	-0.232	-0.401
16	Darjiling	-1.481	-0.586	-1.495	-1.492	-0.586	-1.506	-1.526	-1.364	-1.425	2.423	-0.904
17	Koch Bihar	0.453	-0.162	0.449	0.446	-0.162	0.441	-0.623	0.352	-0.265	-0.129	0.080
18	Puruliya	0.608	-0.269	0.6	0.602	-0.269	0.594	-0.382	-1.787	-0.507	1.881	0.107

Source: West Bengal Statistical Hand Book 2012, Bureau of Applied Economics and Statistics, Government of West Bengal.

Food Availability: Food availability comprise of ten sub indicators, namely Availability of cereals, Availability of pulses, Availability of Food grains, Calorie Availability of cereals, Calorie Availability of Pulses, Calorie Availability of total food grains, Livestock Availability, Cropping intensity, Net sown area, No of ration shop per 1000 of population. Availability of cereals, Availability of Food grains, Calorie Availability of cereals and Calorie Availability of total food grains have been highest recorded in the district of Birbhum and Availability of pulses and Calorie Availability of pulses highest recorded in Nadia district. Murshidabad district score highest in Livestock Availability and Cropping intensity then the other district of west Bengal. On the other hand Net sown area and number of ration shop per 1000 of population have been highest recorded in the district of Purba Medinipur and Darjiling districts respectively. The Availability of cereals, Availability of Food grains, Calorie Availability of cereals, Calorie Availability of total food grains, Livestock Availability and Net sown area have been recorded in Haora district. The total composite Z score of food availability has been highest found in Birbhum and lowest in Haora district. The reason for this marked reduction in the food grain production and area is due to the high rate of agricultural land conversion into urban land. The urban land conversion leads to the replacement of food grains cultivation with horticulture crops. Based on the composite z score value of food availability the study area divided into five category. The very high food availability has been found in three district, these are Birbhum, Nadia and Paschim Medinipur, high in the district of Barddhaman, Murshidabad and Bankura, medium in Uttar Dinajpur, Dakshin Dinajpur, Maldah, Koch Bihar, Purba Medinipur and Puruliya, low food availability in Jalpaiguri and South 24 Parganas and on the other hand very low in Haora, Hugli, North 24 Parganas and Darjiling of the study area. Agriculturally developed district like Barddhaman, Birbhum, Nadia, Paschim Medinipur, Murshidabad and Bankura with the help of modern technology, these districts produce huge amount of food crops and the became secure about their food availability as compare to the other district of the West Bengal.

Food Accessibility: Food accessibility is one of the most important indicators of food security. The highest literacy rate has been recorded in South 24 Parganas district and lowest in Murshidabad. The percentage of worker to total population has been found in Koch Bihar district but lowest in Hugli district of West Bengal, In the Koch Bihar district the dependency ratio is minimum as compare to the other district of the study area. Percentage of cultivator to total population is maximum in Darjiling and lowest in South 24 Parganas district. The Puruliya district score highest on number of market/hat per thousand of population in the study area. The average population per bank office (000) and highest food accessibility have been recorded in Uttar Dinajpur and lowest in Darjiling (average population per bank office (000) and North 24 Parganas district of the study area (Z Score Value) The cash crops value is also considered to understand the impact of accessibility of purchasing power of the people on food security because they are the source of good income and thus increase the accessibility resources in the area. In this study the highest food accessibility is found in Purba Medinipur, Uttar Dinajpur and Koch Bihar. Large number of districts (45 percent) is fall in the category of medium food accessibility zone. Low food accessibility has been recorded

Table 3: District wise distribution of food accessibility in the study area (z score)

Sl. No.	Sl. No.	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	Composite z score
1	Barddhaman	-0.529	-0.33	0.038	-0.9	-0.076	-1.133	-0.488
2	Birbhum	-0.475	0.991	0.7	-0.7	1.296	-0.694	0.186
3	Bankura	1.298	-0.566	0.132	-0.85	1.296	-0.475	0.139
4	Purba Medinipur	0.344	1.745	1.047	0.35	1.981	0.183	0.942
5	Paschim Medinipur	0.982	-0.566	-1.476	-0.25	-0.076	-0.694	-0.347
6	Haora	0.931	0.142	-0.53	-0.55	-1.105	-0.913	-0.338
7	Hugli	1.182	-1.415	-1.098	-0.2	-0.419	-0.913	-0.477
8	North 24-Parganas	0.202	-1.132	-0.625	-0.75	-1.448	-0.694	-0.741
9	South-24 Parganas	1.633	0.566	-1.886	-0.3	-0.419	0.841	0.073
10	Nadia	-1.069	-1.038	-0.309	-0.2	-0.419	0.402	-0.439
11	Mursidabad	-1.967	-1.368	0.7	-0.85	-0.762	1.06	-0.531
12	Uttar Dinajpur	-0.17	1.509	1.615	1.6	-0.762	2.375	1.028
13	Daksin Dinajpur	-1.637	-0.047	0.006	2.95	-0.762	0.402	0.152
14	Maldah	-0.185	0.189	-0.278	-0.05	-0.762	0.841	-0.041
15	Jalpaiguri	0.614	-0.802	-0.719	1.35	-0.762	0.621	0.050
16	Darjiling	-0.052	0.613	2.057	-0.7	0.61	-2.01	0.086
17	Koch Bihar	-1.263	1.84	0.89	1.05	0.953	0.183	0.609
18	Puruliya	0.16	-0.283	-0.246	-0.9	1.639	0.621	0.165

Source: West Bengal Statistical Hand Book 2012, Bureau of Applied Economics and Statistics, Government of West Bengal

in Haora, Hugli, Paschim Medinipur and Nadia and on the other hand very low mainly found in three districts namely Maldah, North 24 Parganas and Barddhaman. Due to the high population pressure and lack of bank and market some district are face low food accessibility problems.

Food Utilization: In this study food utilization mainly comprised of major three indicators these are number of hospital bed to total no of population, number of family welfare Centre and percentage of population cover under the water supply schemes. Highest number of hospital bed to total no of population is found in Darjiling (3.472) and lowest in Uttar Dinajpur (-1.189). On the other hand , number of family welfare Centre is highest recorded in two villages namely Barddhaman and North 24 Parganas both are score 1.83 (composite z score)and lowest in Daksin Dinajpur (-

Table 4: District wise distribution of food utilization in the study area (z score)

Sl. No.	Sl. No.	X_{17}	X_{18}	X_{19}	Composite z score
1	Bardhaman	0.93	1.83	0.973	1.244
2	Birbhum	-0.341	-0.215	-0.313	-0.290
3	Bankura	0.294	0	-0.173	0.040
4	Purba Medinipur	-0.553	0.323	0.703	0.158
5	Paschim Medinipur	-0.129	1.184	1.028	0.694
6	Haora	0.294	0	-0.884	-0.197
7	Hugli	0.294	0.215	0.147	0.219
8	North 24-Parganas	-0.129	1.83	0.753	0.818
9	South-24 Parganas	-0.765	1.184	1.903	0.774
10	Nadia	0.718	-0.323	0.401	0.265
11	Murshidabad	-0.765	0.646	1.623	0.501
12	Uttar Dinajpur	-1.189	-1.399	-0.841	-1.143
13	Daksin Dinajpur	-0.341	-1.614	-1.503	-1.153
14	Maldah	-0.977	-0.861	-0.209	-0.682
15	Jalpaiguri	-0.341	-0.753	-0.286	-0.460
16	Darjiling	3.472	-0.861	-1.846	0.255
17	Koch Bihar	-0.341	-1.076	-0.704	-0.707
18	Puruliya	-0.129	-0.108	-0.772	-0.336

Source: West Bengal Statistical Hand Book 2012, Bureau of Applied Economics and Statistics, Government of West Bengal

1.614). The maximum percentage of population cover under the water supply schemes has been recorded in South 24 Parganas (1.903) and minimum in Darjiling (-1.846). The overall food utilization, in the district of Bardhaman (1.244) scores the highest Z score value and lowest in Daksin Dinajpur (-1.153). Based on the composite z score very high food utilization zone consist of four districts, these are Bardhaman, Paschim Medinipur, North 24 Parganas and South 24 Parganas. The high food utilization has been found in only one district (Murshidabad) of West Bengal. Out of the total district of West Bengal more than 40 percent districts fall in the zone of medium food utilization group. The Jalpaiguri and Puruliya fall in low category and four districts namely Koch Bihar, Uttar Dinajpur, Daksin Dinajpur and Maldah in very low category of food utilization zone.

Table 5 District wise distribution of food stability in the study area (z score)

Sl. No.	Sl. No.	X ₂₀	X ₂₁	X ₂₂	X ₂₃	X ₂₄	X ₂₅	X ₂₆	Composite z score
1	Bardhaman	0.791	1.96	0.417	1.209	1.587	0.464	2.304	1.247
2	Birbhum	0.395	-0.298	-0.224	0.795	-0.269	0.464	0.511	0.196
3	Bankura	-0.198	-0.21	-0.476	1.287	1.236	0.464	0.522	0.375
4	Purba Medinipur	2.569	1.898	-0.76	-0.247	-1.467	0.464	0.587	0.435
5	Paschim Medinipur	-0.198	-0.542	0.102	0.362	-0.797	-3.522	-0.149	-0.678
6	Haora	1.976	-0.389	3.045	-1.647	0.356	0.464	-0.984	0.403
7	Hugli	0.395	2.735	0.165	1.106	1.735	0.464	0.536	1.019
8	North 24-Parganas	0.593	-0.474	0.985	0.18	-0.003	0.464	0.955	0.386
9	South-24 Parganas	-0.593	-0.549	-0.024	-1.09	-0.333	0.464	-2.188	-0.616
10	Nadia	-0.198	-0.527	-0.508	0.267	-0.744	0.464	0.62	-0.089
11	Murshidabad	-0.198	-0.366	-0.476	0.125	-0.436	0.101	0.633	-0.088
12	Uttar Dinajpur	-0.791	-0.39	-0.865	1.178	-0.5	-0.986	-0.702	-0.437
13	Daksin Dinajpur	-0.988	-0.532	-0.855	0.073	-0.472	0.464	-1.391	-0.529
14	Maldah	-0.791	-0.488	-0.539	0.768	-0.783	-0.261	-0.581	-0.382
15	Jalpaiguri	-0.988	-0.499	-0.371	-1.561	1.199	0.464	0.712	-0.149
16	Darjiling	0.395	-0.529	1.805	-1.829	0.734	0.464	-0.76	0.040
17	Koch Bihar	-0.988	-0.263	-0.876	-1.025	0.8	0.464	-0.359	-0.321
18	Puruliya	-1.186	-0.537	-0.529	0.05	-1.844	-1.348	-0.267	-0.809

Source: West Bengal Statistical Hand Book 2012, Bureau of Applied Economics and Statistics, Government of West Bengal

Food Stability: Remaining seven indicators are selected for the explanation of food stability namely number of co-operative society per thousand of cultivators, Cold storage capacity in quintal, number of bank to cultivator's ratio, productivity of food grains, productivity of cash crops, electrified village in percentage and length of road in kilometers. The highest number of co-operative society per thousand of cultivators has been recorded in Purba Medinipur (2.569) and lowest in Puruliya (-1.186). Cold storage capacity in quintal and productivity of cash crops have been highest recorded in Hugli district of the study area. Bankura (1.287) district has been score highest rank in productivity of food grains among the other district of the study area and lowest in Darjiling (-1.829). The highest food stability is show in the district of Bardhaman and low in Puruliya with composite Z score value 1.247 and -8.09 respectively (Table 5). The very high food stability has been recorded in Bardhaman and Hugli districts of the study area, high in North 24 Parganas, Haora and Purba

Medinipur, medium in Nadia, Birbhum, Murshidabad, Jalpaiguri and Darjiling on the other hand very low food utilization has been found in seven blocks, which cover more than 40 percent of the total district of the study area.

Table 6 District wise distribution of food security in the study area (composite z score)

Sl. No.	Sl. No.	Food Availability	Food Accessibility	Food Utilization	Food Stability	Food Security
1	Barddhaman	0.357	-0.488	1.244	1.247	0.590
2	Birbhum	0.986	0.186	-0.29	0.196	0.270
3	Bankura	0.399	0.139	0.04	0.375	0.238
4	Purba Medinipur	-0.138	0.942	0.158	0.435	0.349
5	Paschim Medinipur	0.66	-0.347	0.694	-0.678	0.082
6	Haora	-1.234	-0.338	-0.197	0.403	-0.342
7	Hugli	-0.457	-0.477	0.219	1.019	0.076
8	North 24-Parganas	-0.815	-0.741	0.818	0.386	-0.088
9	South-24 Parganas	-0.409	0.073	0.774	-0.616	-0.045
10	Nadia	0.795	-0.439	0.265	-0.089	0.133
11	Murshidabad	0.587	-0.531	0.501	-0.088	0.117
12	Uttar Dinajpur	0.149	1.028	-1.143	-0.437	-0.101
13	Daksin Dinajpur	0.12	0.152	-1.153	-0.529	-0.353
14	Maldah	0.111	-0.041	-0.682	-0.382	-0.249
15	Jalpaiguri	-0.401	0.05	-0.46	-0.149	-0.240
16	Darjiling	-0.904	0.086	0.255	0.04	-0.131
17	Koch Bihar	0.08	0.609	-0.707	-0.321	-0.085
18	Puruliya	0.107	0.165	-0.336	-0.809	-0.218

Source: West Bengal Statistical Hand Book 2012, Bureau of Applied Economics and Statistics, Government of West Bengal

The composite Z score value is highest recorded in the block of Barddhaman (0.590) followed by Purba Medinipur (0.349) and Birbhum (0.270) with respect to all has occupied the first place as far as food security of Koch Bihar district is concerned. Daksin Dinajpur (-0.353) is the last ranking block in this regard followed by Haora (-0.342) and Maldah (-0.249). Barddhaman, Birbhum, and Purba Medinipur districts are fall under the category of very high food security zone, Puruliya, Bankura and Nadia in high category, Hugli, North 24 Parganas, South 24 Parganas, Paschim Medinipur,

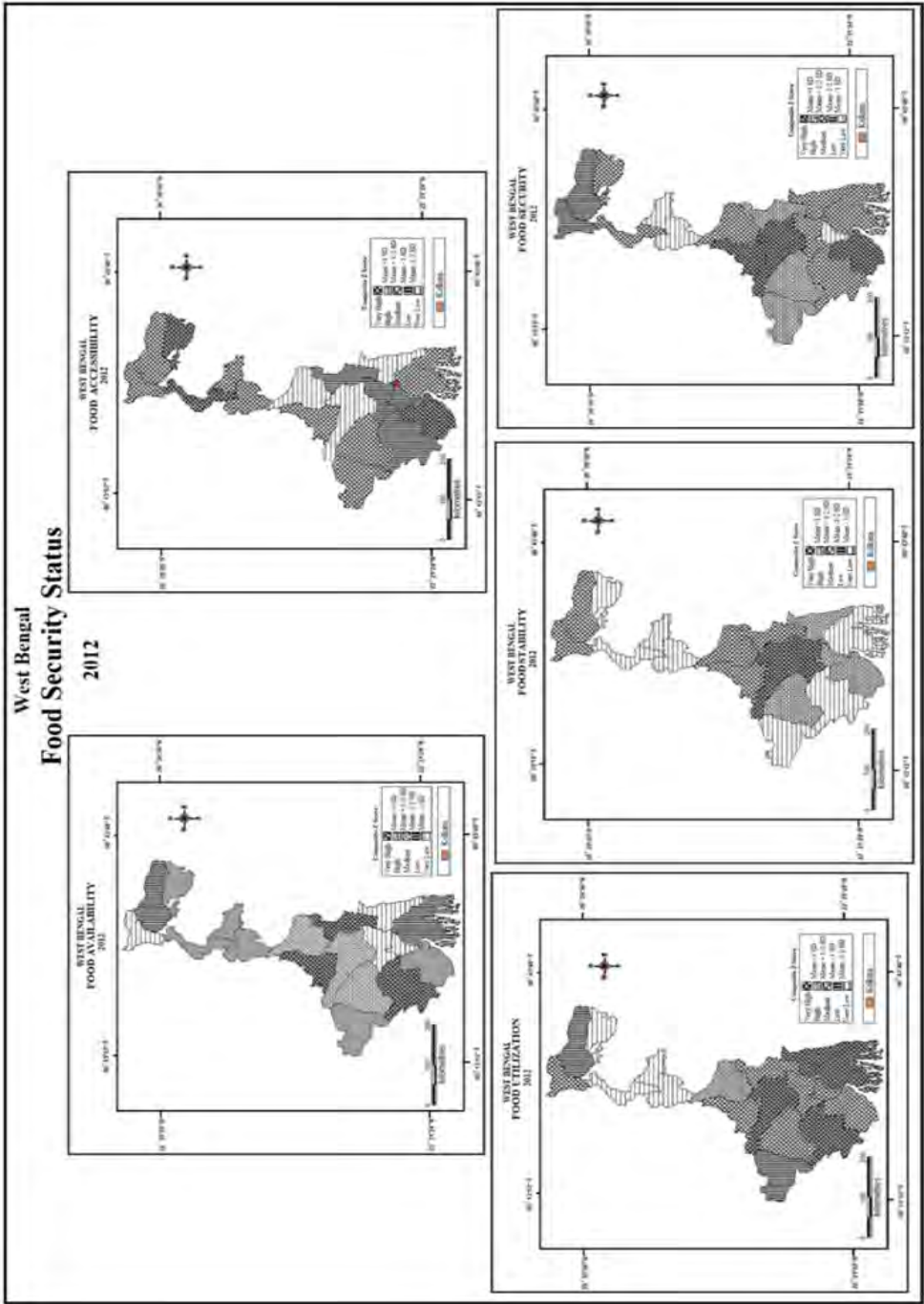


Fig: 1

Sources: Based on the table 2, 3, 4, 5 and 6.

Uttar Dinajpur, Murshidabad and Koch Bihar fall in medium category zone in the study area on the other hand Darjiling and Jalpaiguri in low category and Daksin Dinajpur, Haora and Maldah in very low category group in the study area based on the standard division indexing on z score value.

Table 7 Matrix correlation between Food Security and its indicators in West Bengal (2011)

	Food Security	Food Availability	Food Accessibility	Food Utilization	Food Stability
Food Security	1				
Food Availability	0.51 **	1			
Food Accessibility	-0.07	0.08	1		
Food Utilization	0.60*	-0.04	-0.62*	1	
Food Stability	0.59	-0.20	-0.33	0.45 **	1

Source: Calculated by authors

* Correlation is significant at the 1 percent

** Correlation is significant at the 5 percent

The above table shows that food security is significantly positively co-related with food utilization ($r=0.60$) and food availability ($r=0.51$) at 1 percent and 5 percent level of significant on the other hand food utilization is significantly positively co-related with food stability ($r=0.45$) at 5 per cent level of significant food utilization is significantly negatively co-related with food accessibility ($r=0.62$) at 1 per cent level of significant. Food accessibility is negatively co related with the food security ($r= -0.07$), food utilization ($r= -0.62$) and food stability ($r= -0.33$) in the study area. The food utilization is positively related with the food stability ($r=0.45$). Agricultural developments have increased our production of crops which help to reduce our food deficiency means increase per capital availability of food crops. Implication of modern technology like tractor, fertilizers, insecticides, pesticides, high yielding variety of seeds, irrigation facility total production and yield became double in the study area. Due to the agricultural development in some region of the study area farmers give their attention on the cash crops cultivation for earn huge amount of money, income is positively related with the food accessibility or purchasing power of the people.

Gender Disparity: Gender refers to the cultural, socially constructed differences between the two sexes. It refers to the way society encourages and teaches the two sexes to behave in different through socialization. 'Gender' and the hierarchical power relations between women and men based on this are socially constructed, and not derived directly from biology. Gender is a social construct that impacts attitudes, roles, responsibilities and behavior patterns of boys and girls, men and women in all societies. Increasing attention has been given to the importance of achieving gender equality in education. Table 8 reveals the district wise food and nutrition gender disparity in the study area. From the overall study it has been highest below normal Body Mass Index (BMI) found in Daksin Dinajpur (15.1), Puruliya (23) and Darjiling (6.8) district and lowest in Hugli (-0.6) (Fig: 2).

Table 8 District Wise Food and Nutrition Gender Disparity in West Bengal

Name of the Districts	Body Mass Index (BMI) is below normal (BMI < 18.5 kg/m ²) (%)			Overweight or obese			Face hypertension			Face Anaemic (%)			Literacy (%)		
	Women	Men	Differences (%)	Women	Men	Differences (%)	Women	Men	Differences (%)	Women	Men	Differences (%)	Women	Men	Differences (%)
Bankura	33.3	27.8	5.5	9.4	9	0.4	0.7	0	0.7	66.9	26.9	40	65.2	83.7	18.5
Bardhaman	24	26	-2	17	12	5	0.6	0	0.6	63.3	24	39.3	66.6	72.6	6
Birbhum	30.3	31.6	-1.3	10.3	4.5	5.8	1	1.3	-0.3	63.8	20.8	43	62.1	86.2	24.1
Dakshin Dinajpur	24.9	9.8	15.1	12	11.4	0.6	0.9	0	0.9	77	46	31	67.3	83.2	15.9
Darjiling	15.4	8.6	6.8	23.6	21.1	2.5	1.6	2.8	-1.2	48.3	9.3	39	78	95	17
Haora	16.5	20.1	-3.6	25.9	17	8.9	1.1	0	1.1	58.1	29.3	28.8	78.4	89	10.6
Hugli	18.3	18.9	-0.6	29.9	17.2	12.7	1	1.2	-0.2	63.2	35.1	28.1	76.3	85.8	9.5
Jalpaiguri	26.1	17.4	8.7	14.8	10.6	4.2	1.7	2.8	-1.1	67	39.9	27.1	64.2	74.5	10.3
Koch Bihar	24.8	19.8	5	9.7	9.5	0.2	0.7	1.7	-1	69.1	40.7	28.4	60.8	80.8	20
Kolkata	7.3	17.2	-9.9	40.7	42.8	-2.1	1.1	0.5	0.6	46.4	24.6	21.8	80	84.3	4.3
Malda	23.9	15.4	8.5	12	12.5	-0.5	1.2	0	1.2	59	24.3	34.7	64.2	71.7	7.5
Murshidabad	21.1	19.7	1.4	14.8	11.4	3.4	0.3	0	0.3	57.5	28.6	28.9	66.1	85.1	19
Nadia	11.9	15.6	-3.7	24.9	11.6	13.3	0.8	0.7	0.1	57.1	27.4	29.7	73.7	79.7	6
North 24 Parganas	11.5	17.4	-5.9	28.9	16.5	12.4	0.7	1.5	-0.8	62.7	30	32.7	82.9	80.9	-2
Paschim Medinipur	29.9	26.6	3.3	15.6	12.4	3.2	0.5	0	0.5	67	36.1	30.9	70.7	82.9	12.2
Purba Medinipur	19.4	8.3	11.1	20.9	19.2	1.7	0.6	0	0.6	59	27.2	31.8	76.1	89.3	13.2
Puruliya	47.5	24.5	23	4.7	8.7	-4	0.6	0.7	-0.1	80	44.9	35.1	48.1	76.5	28.4
South 24 Parganas	18.9	23.1	-4.2	22.6	9.7	12.9	0.2	2.1	-1.9	66.8	35.4	31.4	74.6	76.9	2.3
Uttar Dinajpur	25.7	17.4	8.3	11.1	8	3.1	0.7	0.8	-0.1	62.1	38	24.1	51.1	65.1	14
Total	22.7	19.2	3.4	18.4	14	4.4	0.8	0.8	0	62.9	31	31.9	68.8	81.2	12.4

Source—NFHS 4, 2015-2016

Highest gender gap of Below Normal BMI basically found in those districts because of low literacy, education facilities and lack of health facilities. On the other hand Overweight or Obesity gap has been recorded Nadia (13.3), North 24 Parganas (12.4) and South 24 Parganas (12.1). Gender Differences of Hypertension Persons have been very high found in the urbanized district like Kolkata, Haora, North 24 Parganas and South 24 Parganas etc. Gender differences of literacy rate very high Female workers play an important role in agriculture and thus in food production but in this study area number of districts have huge gap in work participation.

Conclusion

People's overall access to food relies to a great extent on the work of rural women. Women comprise, in average, 43 percent of the agricultural labour force in developing countries (FAO 2011). Above analysis clearly gives an impression that the intra district variation in the food security status and pattern in the West Bengal is highly localized in nature and also governed by the broad and general controlling social and physical factors. A detailed analysis of the district level data for West Bengal reveals that the district level food and nutrition security status is well explained by the agricultural factors like availability of cereals, availability of pulses, availability of food grains, calorie availability of cereals, calorie availability of pulses, calorie availability of total food grains, livestock availability, cropping intensity, net sown area and yield etc. in association to the socio-economic and cultural factors –like literacy rate, percentage of worker, percentage of cultivator, number of market/hat, number of post office, bank office number of hospital bed no of family welfare Centre, water supply schemes, co-operative society cold storage etc. Bardhaman, Birbhum, Nadia, Paschim Medinipur, Murshidabad and Bankura districts are enjoy advantageous agricultural development indicators like availability of cereals, availability of pulses, availability of food grains, calorie availability of cereals, calorie availability of pulses, calorie availability of total food grains, livestock availability, cropping intensity, net sown area, indicators found in high level because large percentage of arable land, use of modern technology, credit facility, communication, farmers awareness and government policy which increase agricultural productivity and also production and create a good socio-economic environment to the farmers for their cultivation. On the other hand district like Haora, which is situated near of capital of West Bengal, enjoying a good education facility and modern technology but because of insufficient agricultural land, occupational shifting (primary to secondary) and high population pressure, food availability is low as compare to the other districts. Large percentage of inhabitants of the districts are given more preference in other activities rather than agriculture like daily labour, handicraft, construction worker, business, job, etc. for that some of the district enjoy high agricultural development but face low food and nutrition security. Some of the district like Darjiling has small population pressure but due to undulating topography this region face low food security as compare to other districts. The reason for this marked reduction in the food grain production and area is due to the high rate of agricultural land conversion into urban land. The urban land conversion leads to the replacement of food grains cultivation with horticulture crops. Thus the food security in the study area an effect of the agriculture production is highly correlated. Food utilization is mainly depending on the drinking, sanitation and health. These all sub-indicators of food utilization directly depend on the education and income and this education

is directly or indirectly depends on the government policy. Food accessibility is also the purchasing power of individual or household or country, it's depend on income and also directly depend on employment or working facility. So, need a transparent policy to improve the level of food security. Women are involved in a variety of agricultural operations such as crops, livestock and fish farming. They produce food and cash crops at subsistence and commercial levels. Another emerging challenge in food security and nutrition that needs to be addressed is to enhance women and men's resilience to climate change; e.g. by diversified production as well as strengthened capacity to respond to challenges related to climate change, building on the different needs and coping mechanisms of women, men, boys and girls.

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A Study on Dynamicity of Shorelines and Anthropogenic Activities along the Mandarmani Coast of West Bengal

Jhantu Dey^{1*}, Sayan Samanta¹, Nasira Khatun¹ and Ankita Sen Sharma¹

Abstract : *Historical analysis of shoreline is a widely accepted method for understanding the behaviour of coast. However, it often exhibits some properties which are complex and at the same time difficult to understand. The basic problem of understanding shoreline dynamicity can be solved by using Net Shoreline Movement (NSM) which is useful for understanding the rate of change along a particular area. Rapid growth of tourism activities along with the building of hotels within a very short period of time are some of the major characteristics of Mandarmani. It has great potential for economic development as a growing tourist hub if implemented properly. Establishment of hotels and tourism activities near the erosion prone zone while having an opportunity to establish or locate it on other parts of it, gives the study a unique feature. It shows that both erosion and construction activities are increasing at the same area along the Mandarmani coast.*

Keywords : *Shoreline dynamics, NSM, Tourism, Growth of hotels*

Introduction

Coastal zones are considered to be a delicate environment which acts as a zone of division between marine and terrestrial forces. These are mainly sensitive areas which are vulnerable to several physical and human induced processes. Factors that determine coastline change in an intermediate time scale are far more complicated and include both physical and human induced reasons. Coastal erosion is a severe problem, especially for an area that is experiencing an explosive growth of population in its coastal environment (Kankara R S, 2015). Beside its physical importance's coastal zones also provide bases for development of socio-economic environment around the globe and the changes that occur here affects the loss of life and property, security of harbour, change in coastal socio economic environment and decrease in coastal land resources (Adela R, 2015). So, in order to formulate development activities both in terms of infrastructure and ecology it is necessary to substantiate the rate of change in coastline (Hedge & Akshaya, 2015).

Mandarmani is a transitional zone in-between land and sea where the *Casuarina* and mangrove forests are whispering, sea are roaring, the flora and fauna are blooming, and here visitors can rejuvenate themselves in the company of sand, sea and sun which has kept her doors open to establish the eco-tourism destination (Mandal, K, & Shashi, 2013). Dr. Deb Prakash Pahari in his

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doctoral thesis indicates that Mandarmani has claimed a position in the tourist map of coastal resorts of eastern India within a very short period of time. He has also suggested that rapid and unplanned development has also increased the probability of coast pollution like dune destruction, coastal erosion, mangrove plant deforestation etc. Therefore the study of erosion and accretion pattern in Mandarmani and to some extent how it's related to human interferences in this region has become crucial to estimate.

The Study area

Mandarmani is situated in the south western part of West Bengal which comes under the East Midnapur district. It is surrounded by Pichaboni tidal creek in the east and Jaldi tidal creek in the west. The co-ordinate of the study area lies in-between $21^{\circ}38'42''$ N to $21^{\circ}42'04''$ N latitude and $87^{\circ}38'32''$ E to $87^{\circ}45'49''$ E longitude. Mania and Dakshin Purushottampur, mouzas of Ramnagar Community Development Block.

Objectives of the Study

The present work has been carried out for the following reasons-

- i. To portray the dynamicity of shorelines of Mandarmani coast
- ii. To measure the nature of erosion and accretion
- iii. To analyse the rapid growth of hotels along the coast

Database and Methodology

Satellite images of different time periods (Table 1) were procured from USGS official website and were used to represent and analyse shoreline positions for different time periods.

Table 1: Details of satellite images used in the study

Date of acquisition	Satellite	Sensor	Path/ Row	Resolution(m)
15/12/1987	Landsat 5	TM	139/45	30
24/01/1997	Landsat 5	TM	139/45	30
04/01/2007	Landsat 5	TM	139/45	30
02/01/2018	Landsat 8	OLI	139/45	30

Shorelines were demarcated by using high tide line or the line of vegetation as a proxy for it. Manual determination of shoreline position in a satellite data is a subjective one (Kankara R. S., Selvan, Markose, Rajan, & Arockiaraj, 2015) therefore it may vary from person to person. Shorelines were digitized by using ArcGIS version 10.3.1 and the area has been calculated using Geomatica software. The digitized shorelines were then used to represent Net Shoreline Movement (NSM) which provides an idea about the nature of shoreline movement from the base year to the present.

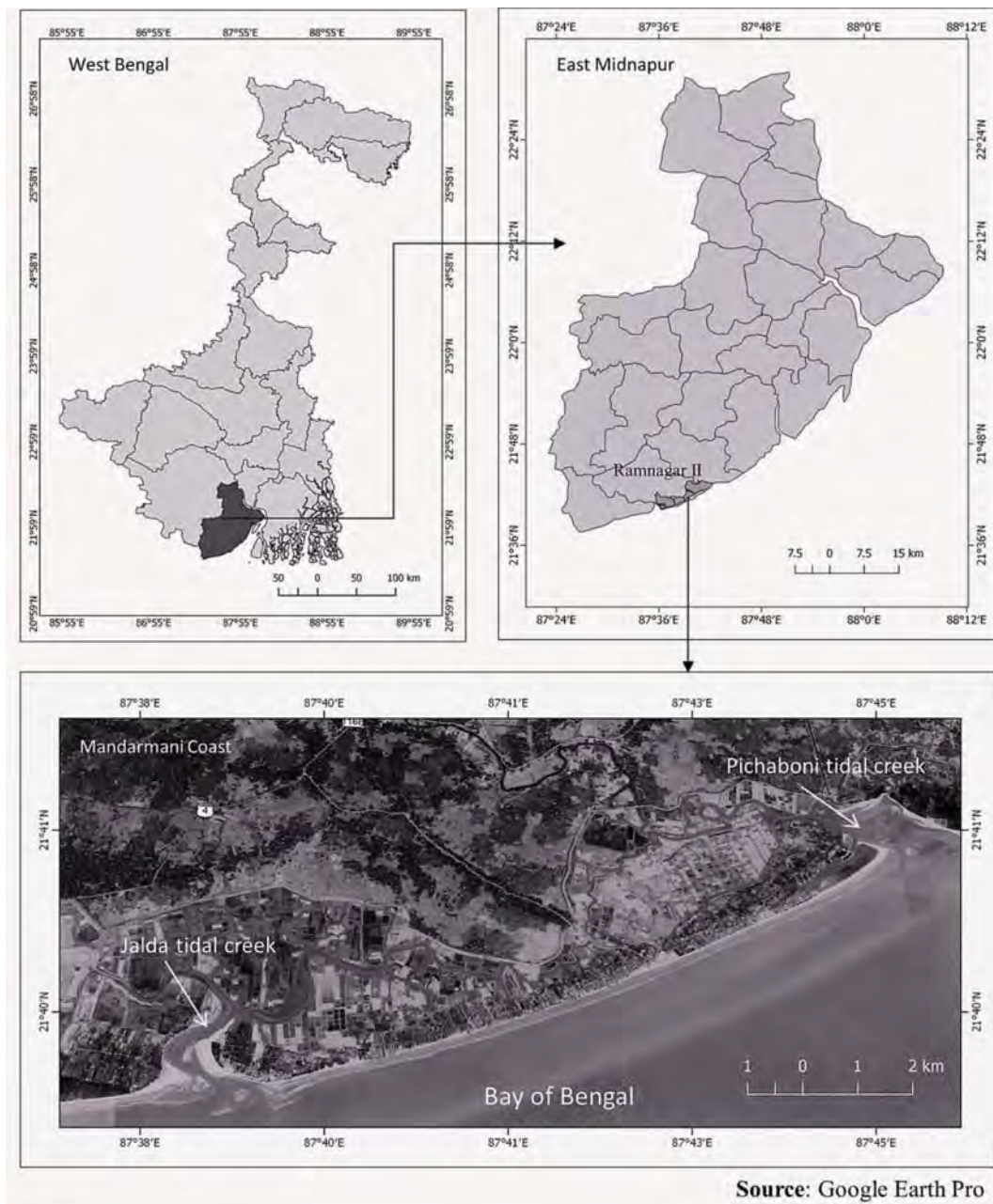


Fig. 1. Location of the study area

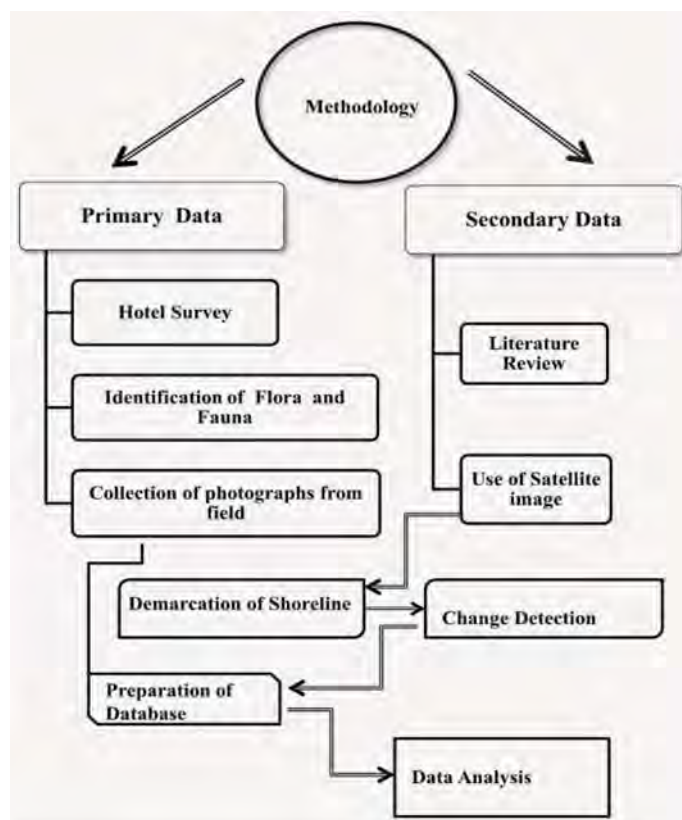


Fig. 2. Methodology used in this study

are indication of changes that systematically occur over the years. Within the selected time period of 32 years Mandarmani coast has experienced an average accretion rate of $71\text{km}^2/\text{yr}$. and an average erosion rate of $25.29\text{km}^2/\text{yr}$. Fig. 3 indicates the position of the shorelines with respect to their dates. It shows the temporal variation that Mandarmani has undergone. Fig. 3. B explains net shift of shorelines that Mandarmani coast has experienced between 1987 to 2018 i.e. the distance between the oldest and the most recent shorelines. NSM shows that Mandarmani is accreting near Jalda and Pichaboni tidal creeks and eroding near the south western part.

Table 2; suggests the exact rate by which Mandarmani is experiencing change from 1987 to 2018. From the analysis of the calculated shoreline data and change of area it is clear that Mandarmani has actually recorded a dominating accretion rate of 2272 km^2 over an erosion rate of 809.3 km^2 of area in between 1987 to 2018 which contributes to a total change of 3081.3 km^2 .

Mandarmani is situated in the northern part of Bay of Bengal and has a 14.20 km long shoreline. The area is comprised of Mandarmani, Silampore, Sonamuhi, Dadanpatrabar,

NSM = Distance between the Oldest and Youngest shorelines

For analysing the growth of hotels, data has been acquired through field survey and literature review. Under the expert advice of Prof. Deb Prakash Pahari the primary data has been collected during the years 2017-18. Furthermore to make our study more relevant, data are used from the unpublished thesis of Dr. Deb Prakash Pahari.

Results

Historical analysis of shorelines

Arrangements of shorelines

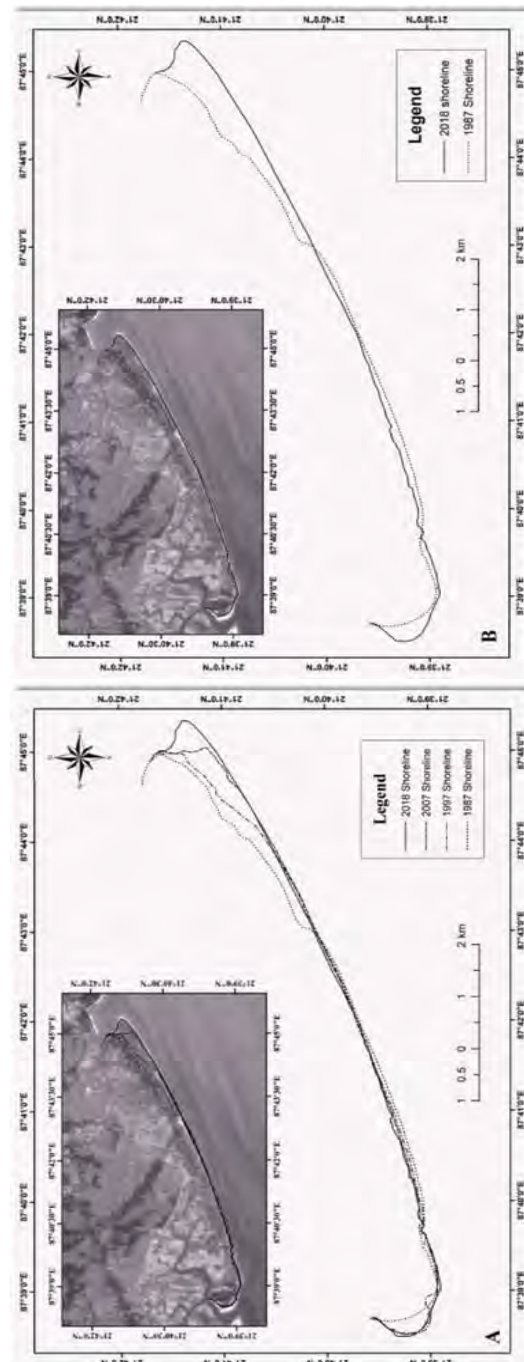


Fig.3. A. Positions of all the shorelines B. Net Shoreline Movement from (1987-2018)

Table 2: Calculated rate of change from 1987 to 2018

Year	Accretion (km ²)	Erosion (km ²)	Total Change (km ²)
1987-1997	1104.9	327.2	1432.1
1997-2007	779.3	160.4	939.7
2007-2018	387.8	321.7	709.5
Total Change (km²)	2272	809.3	3081.3

Growth of hotels

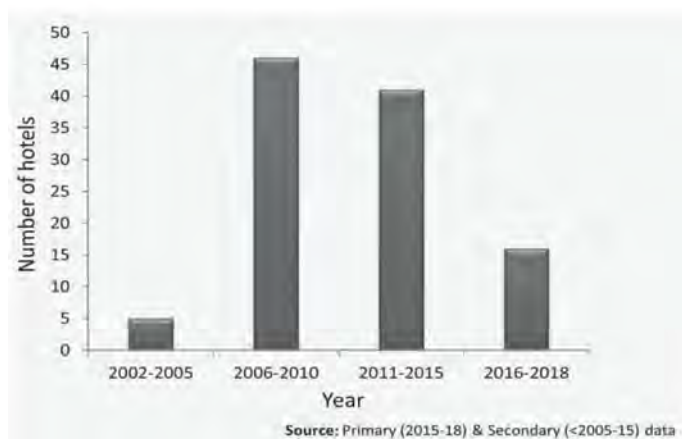


Fig.4. Phases of hotel development at Mandarmani

2010 number of hotels risen up to 46, whereas from 2010-2015 the numbers of new hotels build were 41 and during 2015to2018 this number was near about16. Till date Mandarmani has total 108 hotels. From Fig. 5 this rapid growth can clearly identified.

Discussion

Analysis of the nature of shoreline movement from Fig. 6 shows that both the tidal creeks viz. Pichaboni and Jalda are accreting whereas the south western part of the coastal stretch is actually experiencing erosion. Field study suggests that the areas of tidal creeks are prospering with red crabs and other biogenic features but this were completely absent in case of human influenced coastal stretch of south western part. Field study and cross sectional analysis of human influenced SW stretch suggest that earlier these crabs were present and are validated by the findings of crab burrows within one or two feet from ground. Due to continuous excavation and consequently destruction of sand dunes and illegal construction activities, the natural vegetation of the region like *Cyperus exaltatus*, *Sesuvium portulacastrum*, *Pandanus fascicularis*, *Ipomoea pes-capre* etc.

Tourism activities have started late in Mandarmani. In the beginning of the twenty first century, few hotels grew up which gained a massive pace by the latter part of the century. Fig. 4 explains different phases of hotel development in Mandarmani. The first hotel in Mandarmani initiated in 2002 and was named as hotel Samudrabilash, followed by the development of the second hotel, named as Tarangamala Guest House which also followed the same year. Before 2006 there were only five hotels. Between 2006 and



Fig. 5. Google Earth image depicting change of land use from 2003 to 2018

are being destroyed and hence increasing the vulnerability of the area. This phenomenon accelerates the chances of several natural hazards like salt water intrusion, coastal erosion, storm surges etc. Maximum change of 1432.1 km² has been experienced during the time interval of 1987-1997. Whereas the recent time period of 2007-2018 has undergone 709.5 km² of change and is less than the other two intervals. This could well be an indication for Mandarmani that it is progressing towards a more stable condition. Thus the erosion is balanced by accretion at a nearby similar rate.

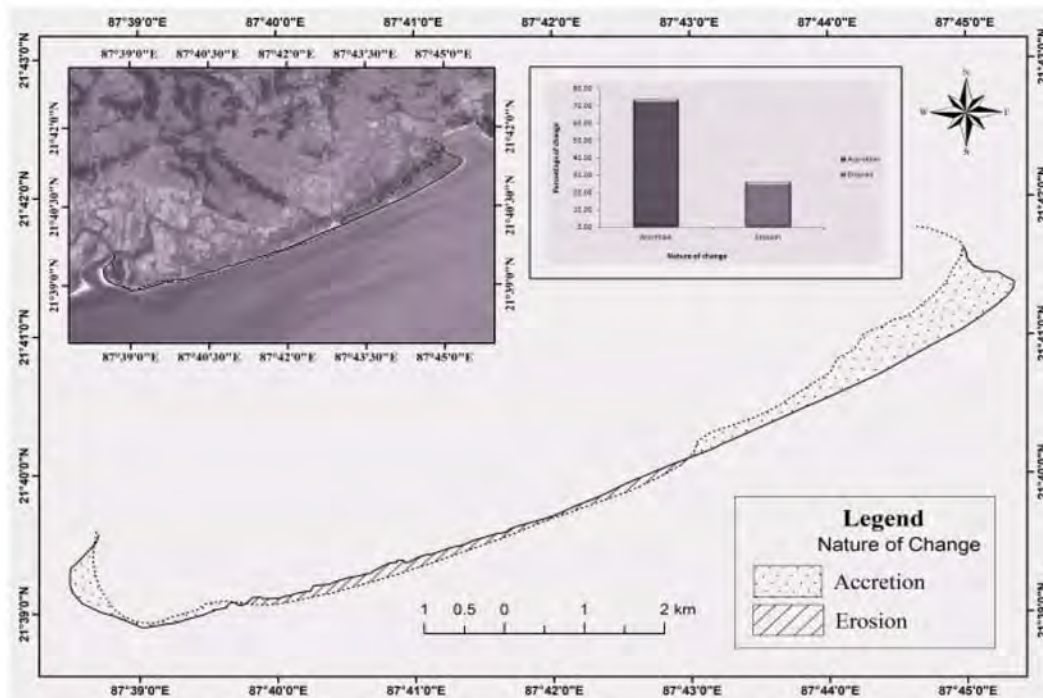


Fig. 6. Nature of shoreline shift of Mandarmani coast

It is clear from Table 2 that, with the on-going time accretion has continuously reduced while erosion shows a fluctuating trend, thus creating a far more complex situation for making any inferences.

From Fig. 7 it is quite clear that the time period 1987-1997 accounts for 35.86 % of accretion and 10.62 % of erosion with respect to the total change experienced in-between 1987-2018. Table 2 shows that the accretion rate of Mandarmani is reducing at an average rate of 22.41 km²/yr. This reducing accretion rate may be due to the increase in anthropogenic activities or due to the betterment of available technology. Although erosional activities shows a more fluctuating trend with a dip in 1997-2007 time period and it continues with an average rate of 25.29 km²/yr.

In terms of growth and development of hotels it has been found that during the time period of 2002-2005 the number of hotels at Mandarmani were 5, since that time it has experienced a huge growth in terms of developmental activities. This growth can well be recognized from Fig. 8. The highest growth of hotels are registered in between 2006- 2010 which was surprisingly 920% higher compared to the base year of 2002-05 having only five hotels. This growth drops to 89 % during 2011-15 time period, which is 20 % lower compared to the previously build 51 hotels but indicates that it retains near about same trend. Furthermore, the establishment of hotels continues, although at a slower rate than the previous one. In 2016-2018 time periods this growth rate has reduced and is 39 %. Field visit suggests that maximum number of hotels lie within the no construction zone and completely violates the CRZ (2011)

Possible Remedies

In order to improve the prevailing conditions few things can be implemented which are as follows -

- i. Demolition of illegally constructed hotels
- ii. Use of sand binding trees like *Casuarina equisetifolia* for protecting coastal dunes
- iii. Relocation of the beach stalls
- iv. Conservation and protection of the natural flora and fauna
- v. Installation of new technology to capture the change precisely this would help in further understanding and improving the prevailing condition

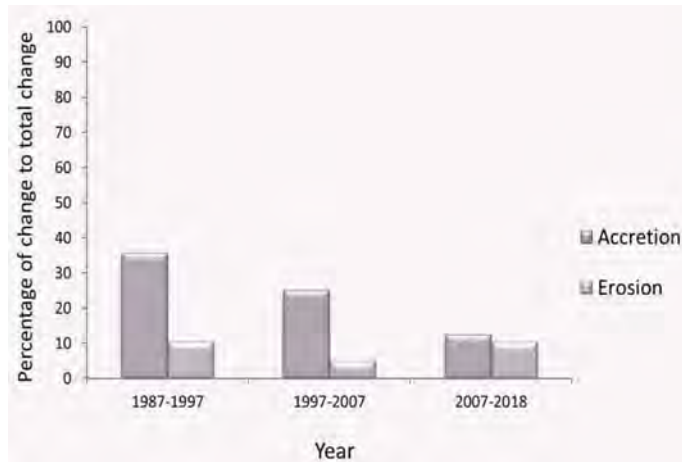


Fig. 7. Changes incurred in three consecutive periods

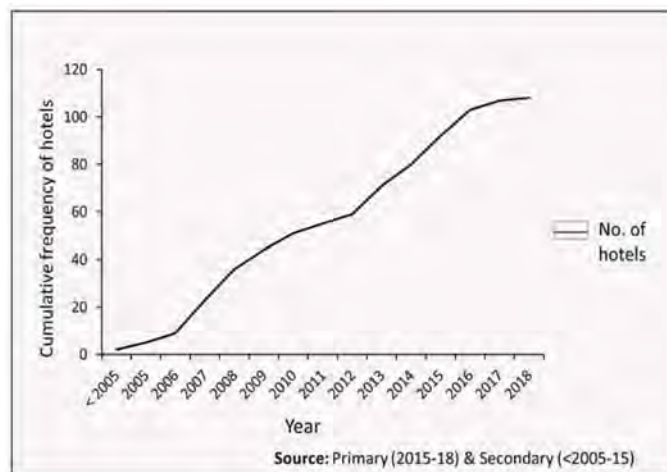


Fig. 8. Growth of hotels from 2002 to 2018 norms.

Conclusion

Analysis of historical shifts of shorelines clearly depicts that the concentration of erosion activities in Mandarmani are limited to only few parts. These area experiences continuous erosion and to further deteriorate such conditions human activities have started to flourish at the same area without any prior knowledge about the nature of the coast. Anthropogenic activities in the form of development of hotels and increasing tourism activities have enhanced processes of toe and other forms of erosion by creating barrier against the sea to protect hotels. As a result, it has led to the destruction and to some extent uprooting of hotels from their bases.

Acknowledgements

We express our genuine thanks to Prof. Sunando Bandyopadhyay, Department of Geography, University of Calcutta and to Dr. Abhijit Chakraborty, Associate Professor of Department of Geology, Jogamaya Devi College; for their excellent guidance in field trip at Mandarmani. We would also like to give a special thanks to Dr. Deb Prakash Pahari, Senior Scientific Officer, Department of Geography, University of Burdwan; for his guidance during hotel survey at Mandarmani and giving us permission to use the much necessary data to support our work and make it more relevant. We are also grateful to Mr. Pritam Kumar Santra (UGC-SRF), University of Calcutta for his continuous support during the field work, analysis and preparation of this manuscript.

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Swachh Bharat Mission – How Far has it Progressed in Urban Centres?

Debalina Guha*¹ and Joydeep Saha²

Abstract : Sanitation has emerged as a key development issue since India's independence. Census of India (2011) has highlighted a glaring data on the lack of toilets in India pointing towards the bad practice of open defecation. In this context, Swachh Bharat Mission (SBM) has come up as the flagship programme dealing with the issues of sanitation. Using the available secondary dataset, this paper attempts to look at the financial progress of this Mission over 2014-2018. It also explores the physical progress made by the Mission in two parameters, i.e. construction of toilets and solid waste management. This study finds that the Mission has slowly addressed state specific demands, but the progress varies across states thereby pointing towards a long road ahead before the destination of clean and open defecation free urban India.

Keywords : Sanitation; Waste; Awareness; Finance; Defecation

Introduction

Since the initial phase of five year planning in India (1951), provisioning of sanitation related services (mainly latrines) in the urban centres has received prime importance in the policymaking domain. During the 1990s, 74th Constitutional Amendment Act envisaged the creation of Urban Local Bodies for proper service delivery and local level planning. Provisioning of sanitation related services gradually turned from a total government-centric initiative to a community-driven programme. Continuing with this broader context, and given the backdrop of 'unclean' cities and towns, Swachh Bharat Mission (SBM) was launched in 2014 with an aim to make India 'clean'. As an important component of 'sustainable urban living' (Ahluwalia and Mathur, 2014) SBM aimed to provide sanitation facilities to every household, including toilets, solid and liquid waste disposal systems. This paper attempts to assess the financial and physical progress of SBM across the states in India over the last four years, i.e. 2014-2018.

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Objectives

- I. To explore the financial progress of Swachh Bharat Mission, over the years 2014-08, across the states of India;
- II. To examine the physical progress of this Mission, in latrine construction and solid waste management.

Methodology

The required state-level secondary data of physical and financial progress has been collected from the official website of Swachh Bharat Mission (Urban), Ministry of Housing and Urban Affairs, Government of India. The database on population size is collected from Census of India website (2011). To make further analysis, few indicators have been calculated –

$$\text{Per Capita Sanctioned Amount} = (\text{Total Sanctioned Amount} / \text{Population Size}) \quad (i)$$

$$\text{Percentage of Sanctioned Fund to Total Allocated Fund} = (\text{Sanctioned fund} / \text{Allocated Fund}) * 100 \quad (ii)$$

$$\text{Per Capita Solid Waste Generation} = (\text{Total Waste Generation} / \text{Population Size}) \quad (iii)$$

Assessment of the SBM so far

Swachh Bharat Mission focuses only on the construction and use of toilets (individual, community, and public) and solid waste management, and hence a possible inclusion of cleaning ‘air’ is also suggested (Banerjee et al, 2017). In some congested parts of cities and towns, Urban Local Bodies (ULBs) do not find suitable land to construct Individual Household Latrines (IHL). Therefore, community toilets are constructed. In the busy stretches of urban centres like bus stops, markets, and road crossings, public toilets are constructed. This Mission also gives due importance to the component of IEC (Information-Education-Communication).

As Swachh Bharat Mission has been promoted as the government’s flagship programme dealing with sanitation related issues, huge amount of funds are planned to be spent. In this context, it would be extremely important to explore to what extent funds have been sanctioned, and if there are statewide variations or not. The following table shows that there are considerable variations across states. A few highly urbanized states like Goa and Gujarat have received relatively higher per capita sanctioned funds. Relatively less developed states like Bihar, Jharkhand, Madhya Pradesh, Chhattisgarh, Rajasthan, and Odisha have also been sanctioned with higher funds in per capita terms. However, this indicator of per capita sanctioning shows lower values in a few states like Sikkim, Kerala, Punjab, Karnataka, Assam, and Haryana.

Table 1: Profile of Fund Sanctioning across States, SBM, 2014-18

State	Fund Sanction (in Rs. Crores) 2014-2018	Total Urban Population 2011	Per Capita Sanctioning (in Rs.)	Sanctioned Fund to Total Allocated Fund (%)
Andhra Pradesh	316.54	28219075	112.17	55
Arunachal Pradesh	17.23	317369	542.91	62
Assam	22.07	4398542	50.17	10
Bihar	234.21	11758016	199.19	40
Chhattisgarh	247.23	5937237	416.40	69
Goa	11.75	906814	129.53	69
Gujarat	451.87	25745083	175.52	54
Haryana	56.73	8842103	64.16	18
Himachal Pradesh	10.85	688552	157.61	31
Jammu & Kashmir	24.87	3433242	72.44	16
Jharkhand	178.39	7933061	224.87	69
Karnataka	194.99	23625962	82.53	19
Kerala	24.44	15934926	15.34	11
Madhya Pradesh	734.90	20069405	366.18	80
Maharashtra	329.79	50818259	64.90	20
Manipur	3.47	834154	41.60	7
Mizoram	18.77	571771	328.28	50
Nagaland	4.19	570966	73.38	13
Odisha	103.65	7003656	147.99	28
Punjab	25.46	10399146	24.48	7
Rajasthan	586.25	17048085	343.88	83
Sikkim	0.86	153578	56.00	9
Tamil Nadu	485.65	34917440	139.09	31
Tripura	7.78	961453	80.92	16
Uttar Pradesh	460.24	44495063	103.44	26
Uttarakhand	19.95	3049338	65.42	20
West Bengal	399.37	29093002	137.27	44
TOTAL	4971.50	357725298	138.98	38

Source: Calculated from Swachh Bharat Mission (Urban) Database, Ministry of Housing and Urban Affairs, Government of India (2014-2018)

It indicates that SBM funds have been sanctioned in the line of 'cooperative federalism' envisaged by the NITI Aayog. Unlike other schemes, SBM has given due importance to state specific demands and allocated required funds on the basis of raised demands. The concerned indicators also reflect how much effort state governments have placed in getting the funds sanctioned. As per the constitution of India, urban development is a state subject, and hence the survey-estimation-designing of project proposals-utilization of funds – all these steps require streamlined efforts of concerned state governments. As a whole, only 38 percent of total allocated fund has been sanctioned yet, showing slow utilization through spending money (Ghosal, 2018). In Rajasthan, Jharkhand, Chhattisgarh and Madhya Pradesh, higher percentage of allocated fund has been sanctioned so far, but states like Uttar Pradesh and NE states show pale picture.

It should be noted that utilization of funds needs to be reflected through the construction of physical infrastructural assets like toilets and dustbins. In short, mere financial progress is neither enough, nor can be done without hand-on-hand physical progress. Funds are released from Government of India to state government in instalments. Only if first instalment of funds are utilized within the stipulated time period, then the second instalment gets released. Therefore, a brief analysis of physical progress – both in the parameters of toilet construction and solid waste management – is attempted in this section.

In India, as a whole, 47 percent IHLs are completed. Some of the states like Chhattisgarh, Gujarat, Jharkhand, Kerala, Tamil Nadu and Punjab have revealed higher levels of progress. It indicates that, following the sustained momentum of sanitation related awareness and growing demand, residents living in urban areas are increasingly preferring to avoid open defecation and opt for IHL. However, it should be cautiously noted that existing database does not allow a researcher to investigate whether constructed IHLs are getting used or not. In Uttar Pradesh, Assam, Odisha and few other states, the physical progress in terms of IHL construction is not very satisfactory. Surprisingly, in a handful states, namely, Arunachal Pradesh, Meghalaya, Sikkim, Mizoram and Bihar, higher number of IHLs are constructed as compared to number of IHL applications received. One should also note that the database on 'use' of latrines is not available, and in this country, latrines are also alternatively used as store rooms or for other purposes.

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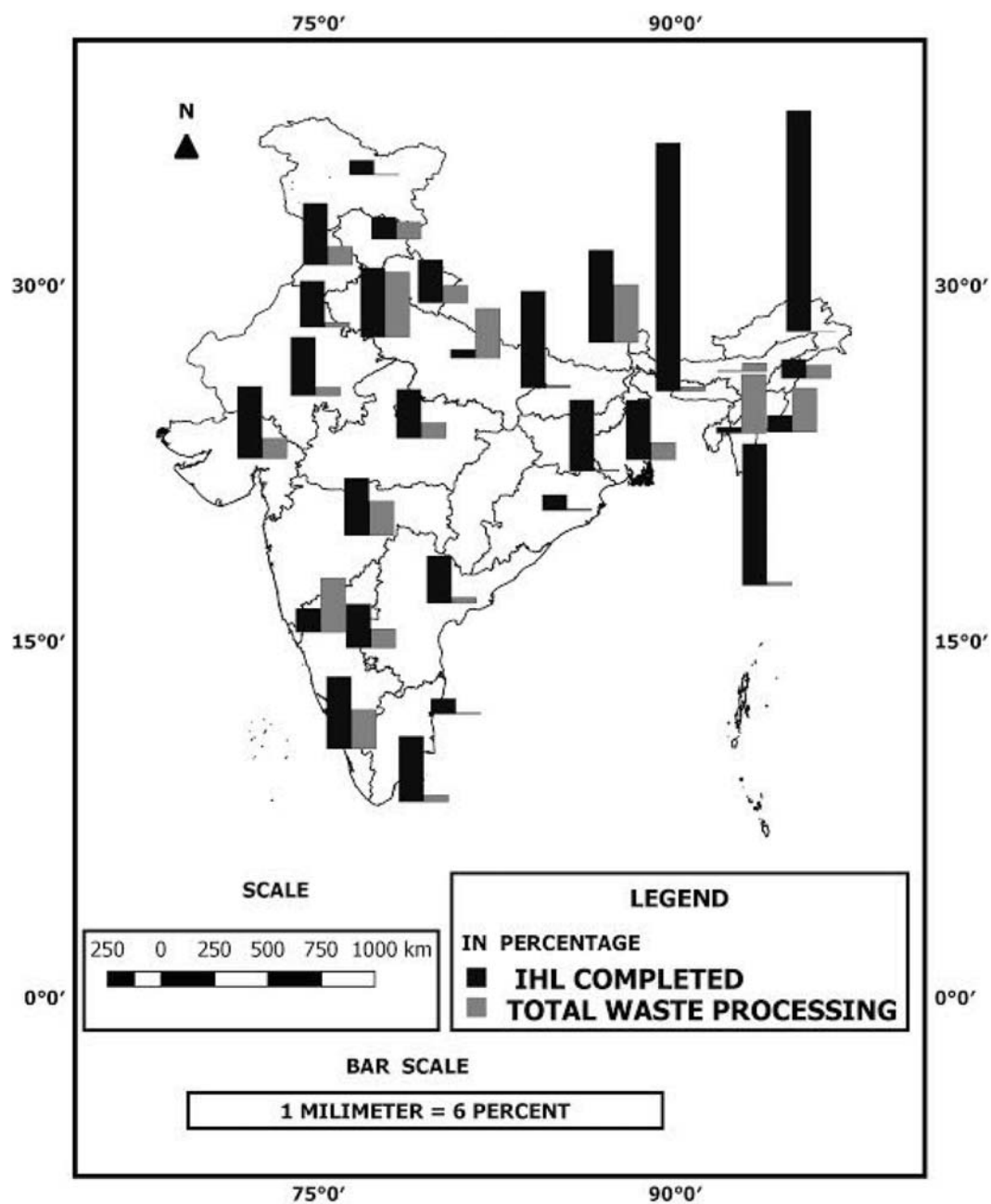


Fig. 1: Physical Progress: IHL and Solid Waste Processing, up to February 2018

So far as solid waste processing is concerned, India shows a value of only 24 percent as a whole (Ghosh, 2016; Henam & Agarwal, 2017). In some states like Chhattisgarh, Tripura and Uttar Pradesh, the corresponding values are higher. Most of the states are in the phase of transition, as probably for the first time, a comprehensive programme like SBM has enabled these states to begin thinking about and implementing waste processing. As for example, small and medium-sized ULBs have been provided with movable compactor machines as a part of SWM practice. SBM is also more important in the present context of urban India where drains often get choked with different categories of solid waste, and piles of garbage littering at public spaces pose public health and hygiene related hazards.

In India, as a whole, 348 tonnes/day solid wastes are generated (Swachh Bharat Mission Urban Database, Ministry of Housing and Urban Affairs, Government of India). This value is lower in states like Kerala, Bihar, Manipur, Andhra Pradesh, Assam, and West Bengal. On the other hand, this value is higher in states like Haryana, Maharashtra, Tamil Nadu and some of the hilly states of India. In Hilly states, probably the rain-soaked moist solid waste leads to higher weight load, and given a smaller size of the population, the per capita values remain higher.

Conclusion

This brief study reveals how SBM is progressing more or less slowly – both in financial and physical terms – across states in India over 2014-18. It is found, on a positive side, that some relatively less developed states like Bihar, Jharkhand, Madhya Pradesh, Chhattisgarh, Rajasthan, and Odisha have received higher per capita sanctioned funds to carry out physical works and awareness generation. SBM has also given due weightage to state specific demands. Physical works related to solid waste processing have also got a momentum. But, there are few things, on the downside that needs to be highlighted. First of all, the amount of per capita sanctioned amount is not much given the magnitude of lack of proper sanitation in urban India. Moreover, the percentage of the sanctioned fund to total allocated fund is less thereby indicating slower utilization at the state level. Secondly, the physical progress of IHL construction is not very satisfactory, especially in states like Uttar Pradesh and Odisha.

Acknowledgement

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Impact of Technological Innovations on Women of Diamond Harbour I C. D. Block, West Bengal

Poulami Debnath¹

Abstract : *Presently, India is approaching towards an impressive pace of economic growth and technological advancements. Technology, market and development are considered gender-neutral. But there is pronounced urban bias and rural negligence in the development process of India. A wide gender gap has persisted over the years at all levels of STEM (Science, Technology, Engineering, and Mathematics) disciplines as well as in technological field throughout the world. Though the enrolment of women in higher education has increased, but they are still underrated. Diamond Harbour I Block is not an exception. This paper aims to contribute to the academic and policy debate in the region by reviewing the main factors put forward in the literature to explain gender inequalities in recruitment, retention, and promotion in STEM disciplines and by providing evidence of the scope and results of policies directed to obtain a better gender balance in the sector. It also tries to find out the developing situation of women in technology, the problem they face and the future prospect of it.*

Keywords : *Technology, STEM Education, Technological Activity*

Introduction

Gender empowerment has been a buzzword in development literature, the concept remains ambiguous. Gender concerns and discourses survive within the development of bureaucracies dominated by men. Since the beginning of planned development, women have been considered as a suppressed section requiring different supportive welfare measures. Most studies and reports on women have only remained unheard, and the information about them reflect the grave situation.

Selection of the Study Area

This paper aims to focus on the participation of women in technological activity which can be justified precisely on the selected study area- Diamond Harbour I Block because this Block is notably lagging behind in terms of female's participation in technological activity or field (Dewan, 2015). So this is the perfect area to assess and find out the root cause of attrition for women to access technology and probable way out from this situation.

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Objectives of the Study

This paper is based on a primary survey of 100 households in Diamond Harbour I Block. It examines the link between technology and occupational pattern of women, the level of female education, and identifies the factors that influence women employment. It appraises that the employment potentials and opportunities for education and technology should ensure the liberation and freedom of thought for all human beings. It should break gradually the shackles of tradition that binds women to the man-made goal. Finally, in this paper, the positive actions in the technological field are summarised, where the barriers are identified and consider some sustainable solution to develop the participation of women. The objectives are summarised as:

- To find out the participation rate of women in the technical field in this locality.
- To assess their problem regarding accessing technology.
- To know their involvement with different technology-related activity.

Materials and Method

In order to attain the main objective of the survey, the research has orientated towards collecting quantitative and qualitative information through the following methods. It comprises of having idea of the study area before visiting it with respect to its location and population. Since this study is principally based on primary investigation, the data was collected through survey of 100 (N =100) representative women regarding the situation related to technological activity of women in Diamond Harbour I Block. The samples are collected through random sampling technique. Then the study comprises of the computation, correction and analysis of the collected data, with the help of suitable cartographic techniques.

Limitations of the Study

Some major limitations regarding this paper are-

- Because of time limit, the research was conducted only on a small size of population.
- Since the survey based on sampling method, it does not disclose the character of the entire female community of other neighbouring areas.

This study, therefore leaves scope for similar investigations in different socio-economic context.

Women and Technology

Women of sub-urban areas generally suffers from absence of opportunities to take part in technological activities or to gather technical knowledge. There are some prevailing constrains, like misconception about technology, stereotype mentality about accessing technology etc. are mainly responsible for their backward situation in terms of technical knowledge or activity. Women in this area have many misconceptions about technological field such as they believe that technology related field is basically male dominated (Kumari, 2010). But now a days the conception is gradually changing. In Diamond Harbour I Block, infrastructural facility is developing day by day. So the tech

related opportunity for women is also developing, like shopping malls, restaurants, cafeteria inaugurated in this area which is partially or fully operated by technology. It creates technology related or technology using job opportunities for the local women.

Perception about Technology

The perception about the technology field continues to be negative. In early 2015, Newsweek published an article entitled “What Silicon Valley Thinks of Women”, and the message it portrayed painted the information technology sector as sexist and misogynist (Faulkner, 2000). In this work a questionnaire survey is used to assess the perception and attitude who did not involve in technology related field but were looking to transition careers. Several discussions occurred on how to get more women into the technology related field. The focus is more on girls who are still in school rather than those that are graduated or already in the workforce. So the survey result reflects that the perception of women in this study area varies from positive to negative. Some prevailing perceptions about technology among women in this study area are that-

- a) Technology is basically male dominated
- b) Technology is expensive
- c) Technology is something which is complex to understand

Educational Status

Women have less access to resource such as property, finance, technology and education that needs to support their active participation in science, technology and innovation. As a result they are lagging behind of in terms of employment on the tech related research, entrepreneurship.

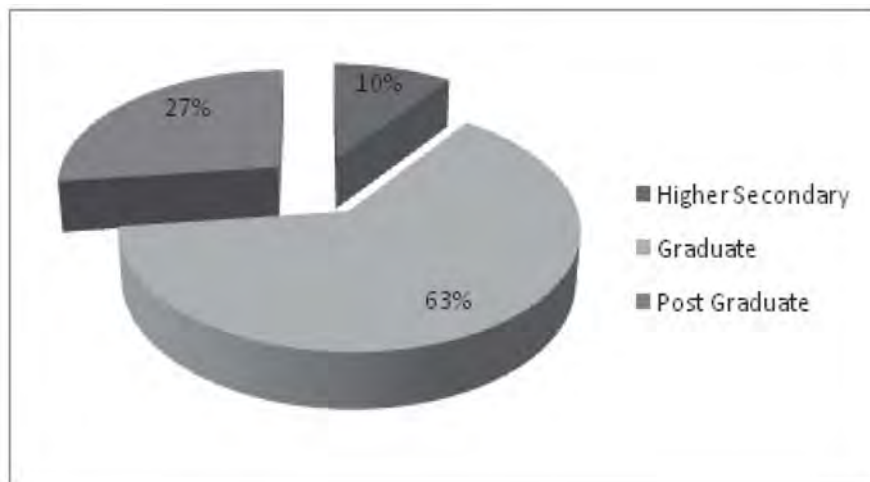


Fig.1. Educational Status

Source: Primary Data, 2018

Among the surveyed population, 10% women are higher secondary pass, 63% are graduated and rest 27% are post graduate, so the scenario of education is pretty good. For the last few years a positive infrastructural development in terms of technological education is going on in this locality that's why the female community get some platform to learn, to engage, to explore the technology.

Participation and Involvement

The scenario of female participation in technology related field or activity in Diamond Harbour I Block is neither very high, nor too poor. Some parts of the local female community are engaged in different types of technology related jobs like mobile service point, tech based cafeteria, different types of institutional technical work etc. So, presently women are smart and the participation rate is also increasing day by day.

There are also two technical institution named Neotia Institute of Technology and Marine Engineering & Diamond Harbour Government Polytechnic College, where the local female community can avail the facility of higher technical education.

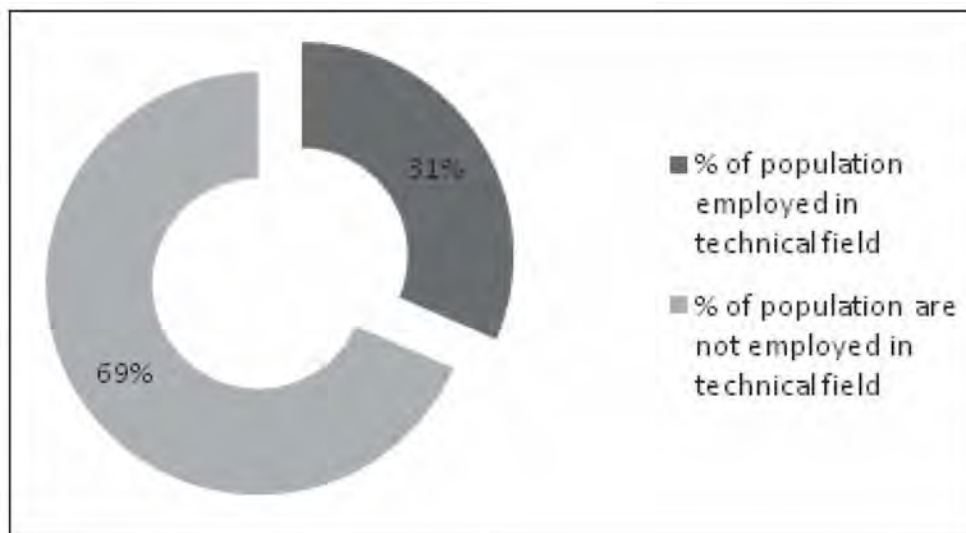


Fig.2. Employment Scenario in Technological Field

Source: Primary Data, 2018

According to Dewan (2015) in Diamond Harbour I area the participation of women in technology related is significantly less. The main reasons behind this situation are their misconception about technology, stereotype mentality about technology and lack of infrastructural development. But, in recent times the situation is improving with increasing female participation in technological field, development of technological knowledge among women and last but not the least, with the overall infrastructural development of the locality. In 1990-91, total female employed population of this

locality is 13% in respect of total employed population, where as in technological field it is remarkably low at 4%. But in the recent times, according to the 2016-17 data 22% of the female employed population to total employed population are engaged in technological field which is quite impressive. So this growth rate is signifying the shifting tendencies among the women.

Women and Internet Communication

Internet communication is something which is one of the prime stimulator in the development, diffusion and expansion of technology. It helps to bridge the gap between human being and technology. Through the internet communication, it has become easier to interact with diverse group of individuals. With the help of internet communication one can learn about technology from their home and as a result the female community of the study area took benefit from it. One of the most important part of internet communication in our daily life in recent times is social media. It makes technology very interesting because social media is a major source of different news, entertainment and a significant mode of modern tech related communication (Chattopadhyaya, 2013). Before the invention of social media, the local female community was less interested about internet technology but after the appearance of social media, the scenario is pole apart from the previous situation. Now a days for the access of social media, internet become one of the basic needs of human life and the same scenario reflects from the female community of this locality.

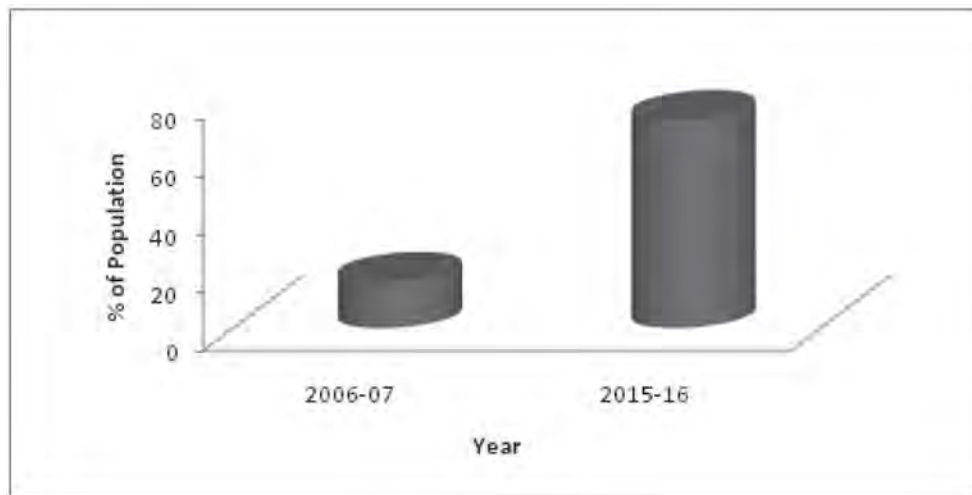


Fig.3. Scenario of Internet Use over the Last Decade

Source: Nielsen Survey Report 2006-07, 2015-16

According to Nielsen survey report (Desai, 2017) in the year 2006-07, only 16% of the female community of Diamond Harbour I Block knows the use of internet but in the year 2015-16 the increased at a significant mark of 72%. One of the main reason behind this rising value over the year is the arrival of social media.

Women and STEM Education

A common definition of STEM education is that it is an interdisciplinary approach of learning where rigorous academic concepts are coupled with real-world lessons as students apply science, technology, engineering, and mathematics in contexts that make connections among school, community, work, and the global enterprise; enabling the development of STEM literacy and with it the ability to compete in the new economy. The word “STEM” stands for Science, Technology, Engineering, and Mathematics. In the last few decades, a significant importance was given to increase women interest in STEM related fields. Female education in STEM represents the child and adult female enrolment scenario in the fields of science, technology, engineering and mathematics.

In the past the STEM education was poor in Diamond Harbour I Block. Before some decade a Marine college established in Diamond Harbour II Block which initiated smart class facilities in its campus. Besides that the recently established Diamond Harbour Womens’ University also provides smart class facility but that is not enough to generate awareness for the whole female community of that locality.

But hopefully the situation is changing with development of several tech- related knowledge centres such as computer centre, e-corners etc. These centres provide an affordable and easy gateway to learn about basic technological knowledge for the local female community.

According to the data published in “District Statistical Handbook-2017’ Diamond Harbour I Block is gradually developing in the matter of widespread access of STEM education. The report states that at present times 40% of the higher educational institutions are facilitated with STEM education and more on the way. This is obviously a boon for the development of local female community.

Major Findings

The major findings observed from this paper are-

- Most of them conceived a wrong perception that technological fields are male dominated.
- There is no as such technological hub present in this location.
- Very little number of population are facilitated with high speed internet connection at home, e-book reader, a computer at home etc.
- Gender gaps in wages are also considers as a significant factor for their less participation.

Way to Go

The current situation of women’s’ participation in technology related fields in Diamond Harbour I Block is not very satisfactory. While the number of women entering the field is developing slowly, there are notable hurdles that cause significant derailment and subsequent attrition. This proposed solutions can be organized under three major categories- the first one is to implement methods and metrics for assessing their perception towards technology; the next step is to develop strategies for increasing awareness about the technology in between the local female community; and the last

one is to provide training, structures, and incentives or disincentives to ensure improved participation in that field. Government should take a lead in that case.

Conclusion

Although gender empowerment has been a buzzword in development debate, the concept is being used in so many different ways that it remains ambiguous. All studies and reports on women status have only remained as a source of data, which rather endorses the passivity of the state. We should reject the touristic observations of women in suburban society, dispel misconceptions and portray the real scenario of Diamond Harbour I Block. This paper sought to address the issue of problems and prospect of women in technology in Diamond Harbour I Block by arguing that the attrition was caused by lack of proper awareness, infrastructure and a negative culture. These items acted as a barrier to keep women out. The case study presented in the results section illustrate this fact by showing the type of culture that permeates the technology industry and the effect the culture has on women. The gender issue should be detach both from economics and insensitive politics. Despite several rules and acts in place, all rights of women are being violated and they have been suffering in silence. Hopefully there are a great deal of initiatives currently running for women in tech, from educational groups hoping to inspire the next generation, to networking events keeping women tied together in the tech sphere.

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Thermal Responses in Peri-urban Environment: A Case Study of Baduria Municipality in North 24 Parganas, West Bengal

Rajat Kumar Paul¹

Abstract : *In the time of heat stress, one's body cannot cool itself enough to sustain a healthy temperature (usual average being 37°C). The goal of this paper is to find out the views of farmers, daily labourers, and indoor people of Baduria Municipality through behavioural responses of thermal condition. People of different occupations feel different temperature, due to their place of work, time duration and type of work. The factors of heat stress are temperature, humidity, air movement, clothing, food habits, and radiation temperature. It is found in Baduria that over 65 percent outdoor people do not wear cotton cloth, and their food habit is comparatively poor. It is also observed that the Body Mass Index (BMI) of almost all the outdoor people is moderate to low. In case of indoor environment clothing and food habits, the conditions are comparatively better than the outdoor people. In the last 12 years, temperature has slightly increased, but rainfall and humidity have a slightly decreasing trend. Natures of human activities play a significant role on heat stress in the study area.*

Keywords : *Thermal Environment, Rural-Urban Interface, Baduria Municipality, Indoor and Outdoor Heat Response*

Introduction

Heat stress in human body occurs when the internal body temperatures fails to adjust with the outside ambient conditions. It is not only due to environmental disruptions and fluctuations, but is also related to the occupational and habitable environment of the victim. It is natural that a person of tropical region faces heat stress many times in his life. In time of heat stress blood flow increases, people sweat more and in cases of severe heat strokes death is common. Kjellstrom et al. (2009) mentions six factors of heat stress. These are air temperature, humidity, air velocity and radiant temperature (environmental), clothing, metabolic heat (personal factors). According to Fischer et al. (2012) if people start to experience heat stress at a higher frequency in the usual environmental conditions, then notable adaptation efforts must be needed in these regions. Heat stress is divided into different types by Brahmapurkar et al. (2012), i.e. heat stroke, heat rash, heat cramps, heat

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exhaustion. In India, workers can experience high heat conditions in any season; and occupational heat stress can have a bad impact on their health and productivity (Venugopal et al., 2015). Actually air temperatures and feel temperatures are different. Previous study reveals that most of the work on urban and industrial heat stress either ignore or have minimum concentration on rural area. The main focus of this research is to understand the behavioural response to thermal condition of Baduria Municipality and its surroundings.

Objectives

The main goal of this paper is to examine the deviations in feel temperature from the actual at the same environmental condition; and to identify the various factors affecting indoor and outdoor population in the study area.

Study Area

Baduria Municipality falls under the C D Block of the same name in North 24 Parganas District of West Bengal, India. It has an area of 209.69 km². The town is situated in the tropical region, within the extension of 22° N of latitudes and 88° E of longitudes. So, it is hot in summer, when the highest day-temperature ranges between 29° C to 40° C. Average temperatures of March to June are

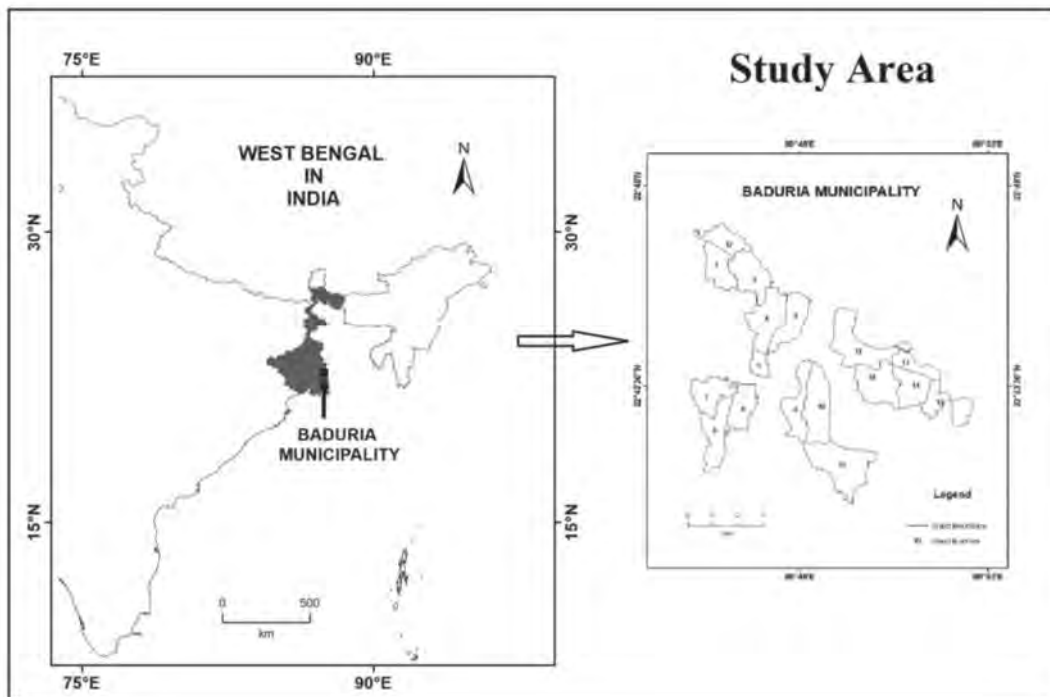


Fig.1: Location map of study area

28°C, 30°C, 31°C, and 30°C respectively. Soil conditions are mainly fertile because of mature delta region. According to Census of India, 2011, 48% of total population are agricultural labourers, the remaining 52% workers are involved in household industry and other works (Govt. of India, 2011). The people here do not have a clear idea and perception about the dangers of heat stress and thermal comforts. In Baduria, the primary sector is dominant economic activity. They have to work under direct sunrays for hours.

Methodology and Data

The study is based on both primary and secondary sources of data. Primary data has been collected through observation and personal interview with the help of questionnaires. Survey responses examined the self-reported pre-existing health conditions, heat-related illnesses and symptoms, indoor/outdoor heat exposure (home, transit, occupational), behavioral adaptations to heat, sources of weather and health information, and social connectedness (Tran *et. al*, 2013). In the year 2015, the summer time responses were collected. A total number of 40 people were interviewed of whom 70% were males and 30% were females. These samples represent equal number of indoor and outdoor population. Secondary data of temperature, humidity, rain fall etc. were collected from various published and unpublished records like Baduria Municipality, NASA open data sources (Giovanni). The behavioural data are based on symptoms like heat stroke i.e. cold, restlessness, irritability, red face and skin, disorientation, hot skin, collapse, unconsciousness, convulsions and death, heat exhaustion i.e. dizziness, weakness, headache, blurred vision, profuse sweating, greyish skin, coma and death, heat cramps i.e. cramping of either active muscles or involuntary muscles, heat rash i.e. skin becomes reddened and may itch, feel prickly or hurt (Kjellström, 2009). The data were then analyzed (BMI, cloth habit, food quality, and feeling temperature) and represented cartographically. The BMI was calculated using the weight and height of an individual with the help of Ancel keys's method (1872). Firstly, the height was transferred into meter then it was squared and finally weight (kg) was divided by itself. Aim for a Healthy Weight classified BMI into different groups like underweight (<18.5), normal weight (18.5-24.9), overweight (25.0-29.9), obesity (≥30). Data of temperature (T) and relative humidity (rh) is calculated to measure the heat stress index (HSI) by the method of Lemke and Kjellstrom (2012).

Results and discussion

Heat-related health impacts

Response towards the heat parameters for indoor and outdoor people is separated and shown through diagrams. Almost 50 % of outdoor people and only 5% of indoor people are facing severe heat effect (Fig.2). Indoor people have an option of to avoiding heat by using fan, shade, chilled water; but outdoor people of Baduria have to work under direct sunrays and hardly drink enough water to keep them hydrated resulting in health injuries.

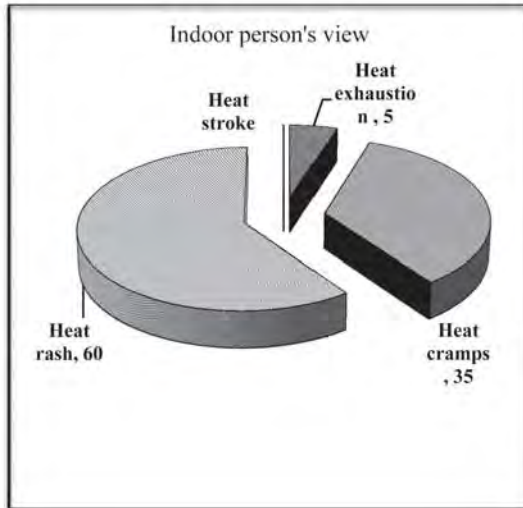


Fig.2.a: Problem of Heat Stress of indoor person

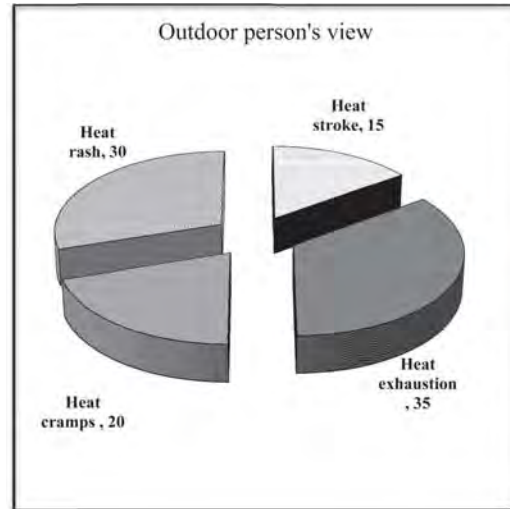


Fig.2.b: Problem of Heat Stress of outdoor person

Source: Field Survey, 2015

Human activity analysis

From this field study, it is observed that about 35% of outdoor people use cotton-type clothes and more than 65% people wear other types of clothes (Fig: 3.b). Those who wear cotton clothes feel comparatively less heat than who wear other types of clothes. Sometimes outdoor workers such as the labour group have to wear protective uniform which is heavy and thick and unable to

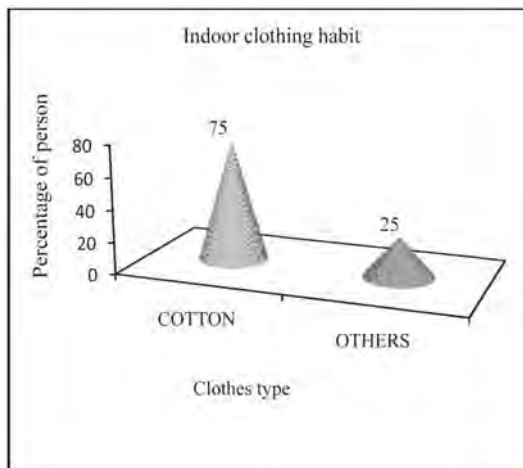


Fig.3.a: Clothing Habit of indoor People

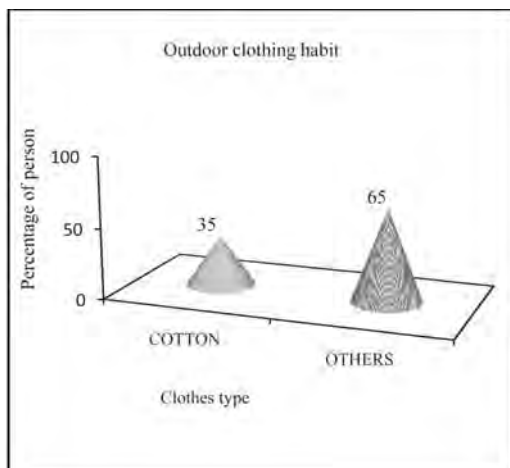


Fig.3.b: Clothing Habit of out People

Source: Field Survey, 2015

ventilate air. On the other hand, over 75% of indoor people wear cotton-type clothes and less than 25% people use others types of clothes. So indoor people feel more comfort than outdoor ones (Fig: 3.a).

Zifferblatt et al. (1980) found that employee of a company changes their food habits with increasing temperature, decrease cooked vegetables, starches and increase fruits, salads, cheese at noon. Here over 45% of indoor people eat the healthy food like fruits, vegetables, nuts, pulses, grains etc. As a result the effect of temperature on them is lower than outdoor people. In this rural area outdoor persons like farmers, daily labourers do not have enough healthy food. As a result their heat adaptation power is less. Over 70% of the outdoor people get unhealthy food like junk food, vegetable oil, stale bread etc.

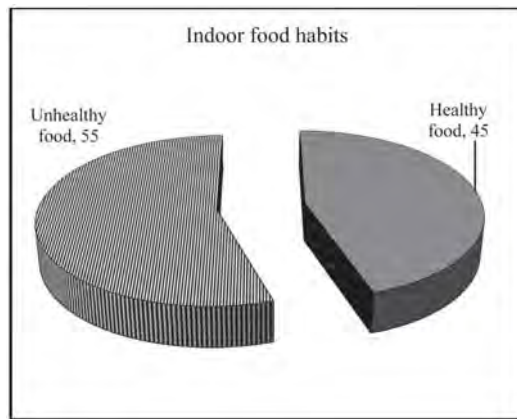


Fig.5.a: Food Habits of indoor People

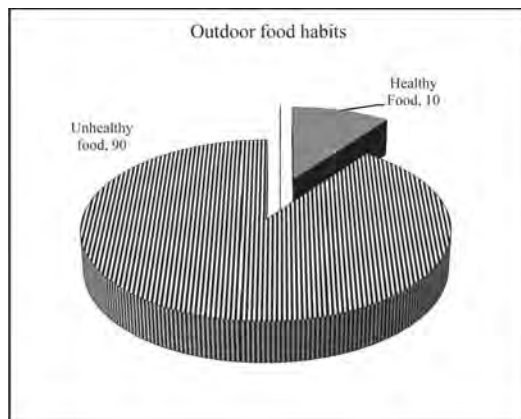


Fig.5.b: Food Habits of outdoor People

Source: Field Survey, 2015

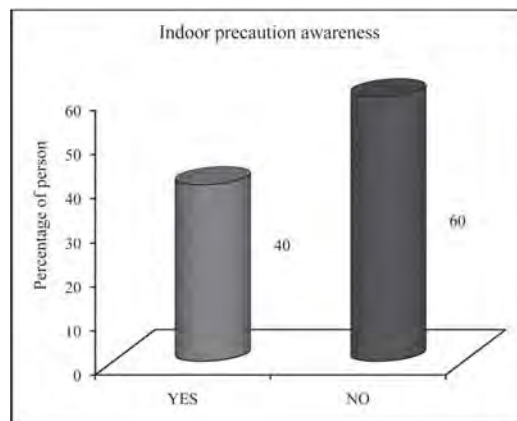


Fig.6.a:Precautionary awareness of indoor people

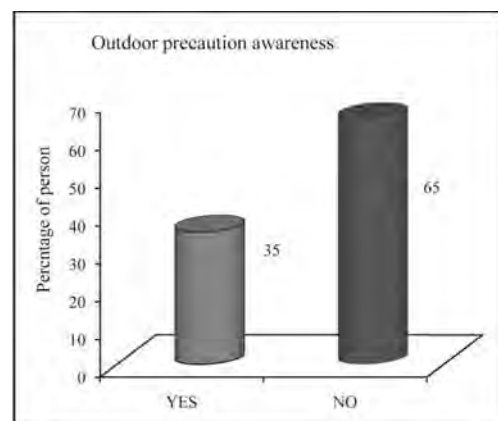


Fig.6.b: Precautionary awareness of outdoor people

Source: Field Survey, 2015

Precautionary awareness is one of the main factors to avoid heat wave. It is found that (Fig. 6) more than 60% of indoor people do not take any precaution; and more than 65% of outdoor people do not take precautionary measures while 35% of people take some precautions to avoid the scorching of heat. It is desirable to protect people from the heat so that one can survive from heat stress. BMI of almost 50% of Indoor people is under weight, and 35% people belong to normal and very few have overweight of BMI. In case of outdoor persons it is found that there is nobody who belongs to over weight of BMI in the rural areas, especially farmers and labourers as about 85% people belong to the underweight and only 15% people belong to normal weight of BMI (Fig 7.b).

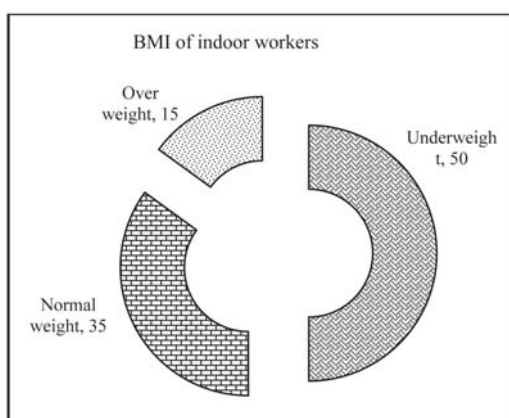


Fig.7.a: BMI of indoor workers

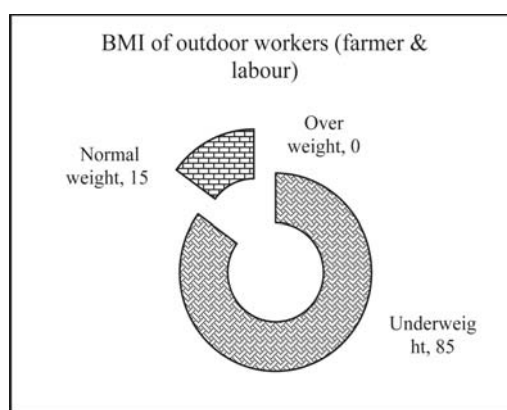


Fig.7.b: BMI of outdoor workers

Source: Computed by the author

Analysis of weather elements

Trend of precipitation

Since 2006, the average rainfall has been gradually decreased (Fig.9). In the last 12 years it is seen that the rainfall was quite low in 2010 ($r = 0.162$). This may be related to heat stress on human

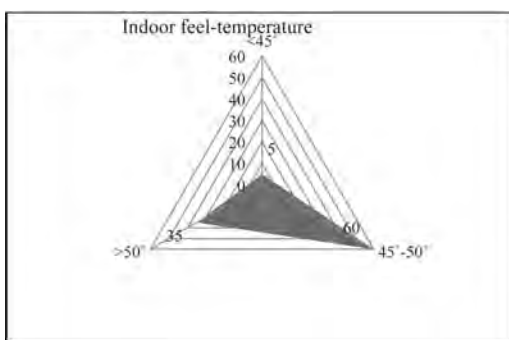


Fig.8.a: Feel Temperature (°C) of Indoors

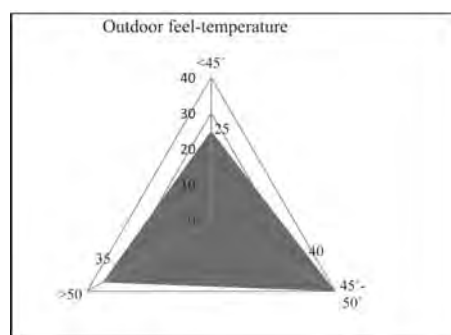


Fig.8.b: Feel temperature (°C) of Outdoors

Source: Computed by the author

being.

Trend of relative humidity

In the years of 2006, 2007, 2008 the average relative humidity reached its peak i.e. more than 70% (Fig.10). In these years heat didn't affect very much. After these three years humidity was reduced in proportion with rainfall (R value is -0.232). It is well known that lower humidity increases heat stress.

Trend of temperatures

Temperature affects human comfort, and heat wave results discomfort. In view of temperature it can be seen that the highest temperature was in the year of 2010, and the lowest in 2006. In this diagram the trend of temperature has increased with time (+0.210). So the effect of heat stress is seen to be getting high proportionally (Fig: 11).

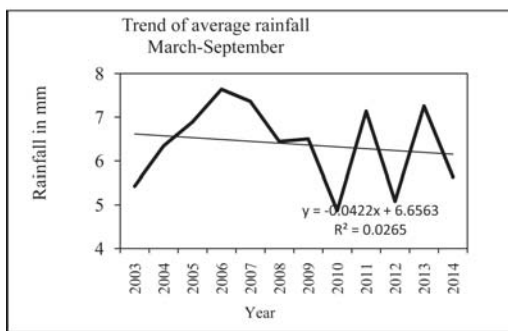


Fig.9: Trend of Rainfall per day (MM)

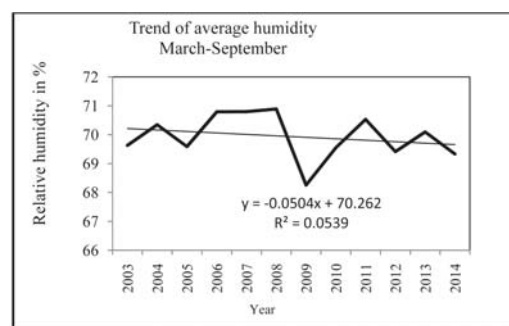


Fig.10: Trend of humidity (%)

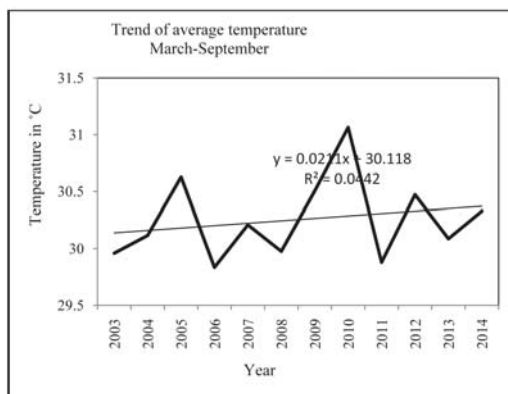


Fig.11: Trend of Temperature (°C)

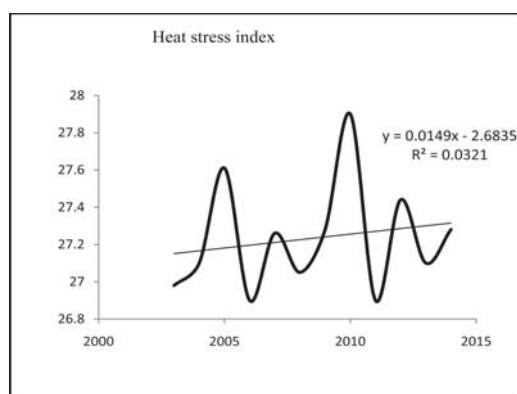


Fig.12: Trend of HSI (°C)

Source: AIRSdata

Feel-temperature

It is not the real temperature. Feel-like temperature is based on air temperature, humidity and the speed of the wind. It evaluates how a man feels temperature. Here, feel-temperature of indoor people varies from one to another. More than 60% of indoor people feel this temperature as 45°C-50°C, whereas the actual temperature is not more than 40°C (fig: 8.b). Here more than 75% of outdoor people feel the temperature more than 45°C. It is quite natural as farmers, who work in outdoor environment, take direct sunlight. But, about 25% of people feel it less than 45°C, because either they are in a room or get some shade in the working hours (fig: 8.a).

It is seen that rainfall and relative humidity curve increase and decrease respectively, and temperature curve is inversely proportional to the rainfall and humidity. HSI is always similar with temperature. In the year 2010, temperature and HSI reach their highest value, and on these years rainfall and relative humidity are low. Although the values of 'R' of different physical factors are low, but it is evident that temperature is gradually increase, and rainfall and humidity decrease within period of study.

Major findings

- Beside weather elements human activities play pivotal role in heat stress.
- People don't have proper idea about how they can get rid of heat stress and related problems.
- Indoor people of Baduria moderately take protection against factors responsible for heat stress but outdoor people have no choice about it.
- In both cases of indoor and outdoor people, most of them have feel-temperature remained within 45°C-50°C. The outdoor people have more adaptive capacity.
- BMI of people vary highly because indoor people contain healthy or succulent food, but on working time outdoor people eat usually unhealthy food.

Conclusion

Heat stress reduction is much-needed both urban and rural areas. In case of Baduria, people have to be more aware about it. On the basis of this study, it is clear that the indoor people do not face many problems because they somehow manage heat stress, but the outdoor people have no choice. But their adaptation capacity is high compared to the indoor people. It is recommended that if outdoor people get some basic protection like 10 minute rest within 1 working hour then they can avoid heat stress.

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