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# Community perception on climate change impacts and related ground water quality issues at southern part of rajnagar block of Kendrapara District, Odisha

**Upama Chatterjee and KM Sethy**

**Abstract**
Community level perception on Climate Change Impacts and related Ground Water Qualities are needed to be discussed while talking about one of extreme climatic events like Cyclones, Heavy Rainfall, Storm Surge, Floods 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. Ground Water sample has been collected from various tube wells for quality testing. The objective of this study is to investigate communities' dependency on fresh water resource for specific usage and the quality of drinking water, which is directly related to extreme climatic events. The study reveals that 42% of the respondent thinks the effects of adverse climate impact lies upon 'reduced water availability, health issues and impact on agricultural production'. 28% of the respondent reported the available water is not clean, and 18% expressed their view that it is salty. With ground 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 ground water issues of the coastal communities of Rajnagar Block.

**Keywords:** Climate change impacts, community's perception, fresh water availability, dependency on fresh water, ground water quality assessment

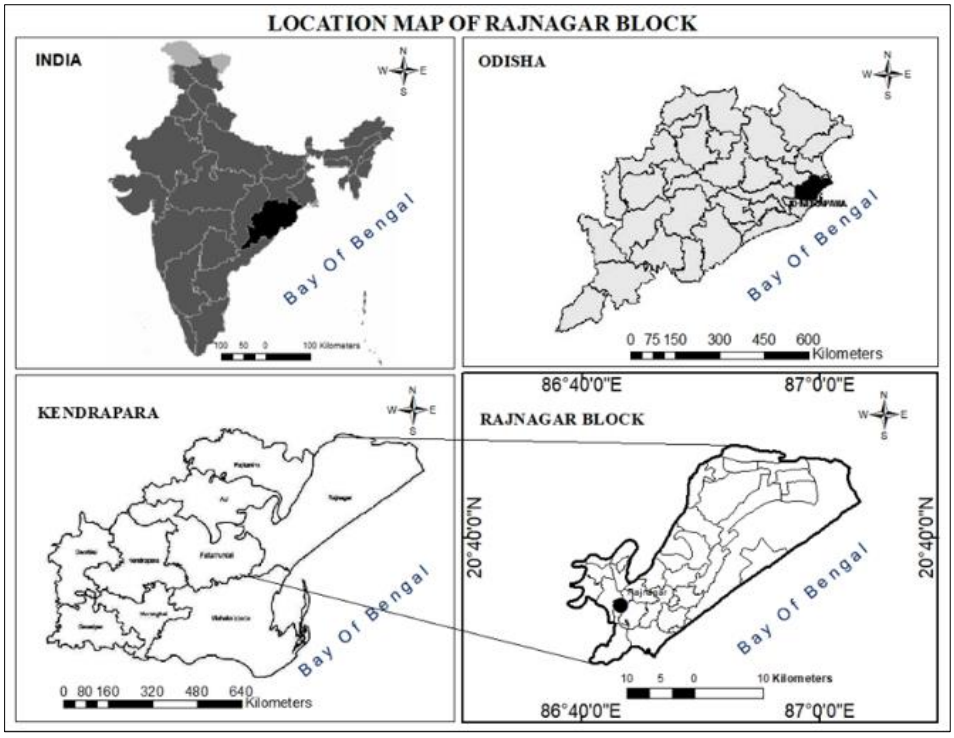
## Introduction
Climate Change and its impact is a common phenomenon not only to any specific study area but also it is a threat to the whole world today. Climate Change is expected to affect coastal communities around the world, many of which are already considered vulnerable to ongoing climatic variability (4th Assesment Report of Intergovernmental Panel on Climate Change (IPCCC), 2001) [1].

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 one of extreme climatic events i.e. Cyclone, Floods, Storm Surges and it's linkage with existing ground water issues as they are common stakeholders suffering from the adverse effects of Cyclonic events.

## Objective
The soul objective of the study is to explore Community Perception on Climate Change Impacts and to investigate communities' dependency on ground water resource for specific usage and the quality of ground water, which is directly related to extreme climatic events i.e. Cyclones, Floods, Storm Surges.

## Study Area
Kendrapara District, in the East Coast of Odisha, is one of the worst victims of Cyclone and Flood and is suffering from waterlogging and salinization. As a consequence this area is facing ground 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 panchayat has been selected to carry out the study.Rajnagar Block lies between 20°30′5″ to 20°47′34″ North latitudes and 86°38′44″ to 87°5′36″ East longitudes.




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

## Methodology

Perceptions on climate change impacts of the community is a qualitative kind of research. It is necessary to get a complex, detailed understanding of the issue (Creswell, 2007) [4]. Responses has been obtained by the primary data collection of 85 randomly selected household of 37villages 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, 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.

## Result and Discussions

### Responses of Respondents

Most of the Respondents perceived that the variability in climate has 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 floods and cyclones over past as well as recent years (Table 4). Over 96 % 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 causing faster evaporation resulting to dryness in soils. But intense rainfall with heavy downpours leading to more occurrence of Flood. They identified Climate change impacts i.e. Cyclones, Floods as serious issues for their daily life, Cultivation, health and overall livelihood. 31 % respondents found cyclone as a severe threat to their life (Table 3).

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

| Perception on Climate Change Impacts | Perception | Household | % |
|---|---|---|---|
| Duration (days) of Rainy Season decreased | Yes | 82 | 96.47% |
| | Maybe | 2 | 2.35% |
| | No | 1 | 1.18% |
| duration (days) of rainy season decreased total | | 85 | 100.00% |
| Temp. Increased during Summer | Yes | 82 | 96.47% |
| | Maybe | 1 | 1.18% |
| | No | 2 | 2.35% |
| Temp. Increased during Summer Total | | 85 | 100.00% |

***Source:*** Primary questionnaire survey of house hold, 2017

**Table 2:** Rainfall Occurrence of Last Ten Years

| Rainfall in Coastal District: Kendrapara (Odisha) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Rainfall in mm. for the month of June** | **Year** | | | | | | | | | |
| | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** |
| Actual | 156.6 | 190.2 | 431 | 35.56 | 96.5 | 421.4 | 90.2 | 229.9 | 121 | 121 |
| Normal | 208.3 | 208.3 | 208 | 208.3 | 208.3 | 208.3 | 208 | 208.3 | 208 | 208 |
| Deviation | -51.74 | -18.08 | 222 | -172.7 | -112 | 213 | -109 | 21.64 | -87.3 | -87.3 |

***Source:*** Directorate of Economics & Statistics, Orissa, Bhubaneswar

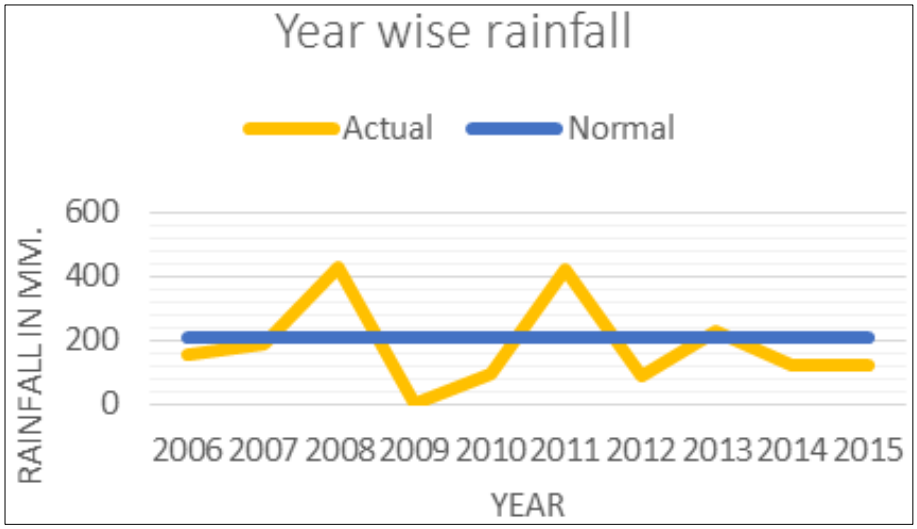



**Fig 1:** Rainfall occurrence of last ten years

**Table 3:** Perceptions of natural hazard scenario

| Natural Disaster | Low | % | Moderate | % | High | % | Severe | % | Grand Total | % |
|---|---|---|---|---|---|---|---|---|---|---|
| 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% |

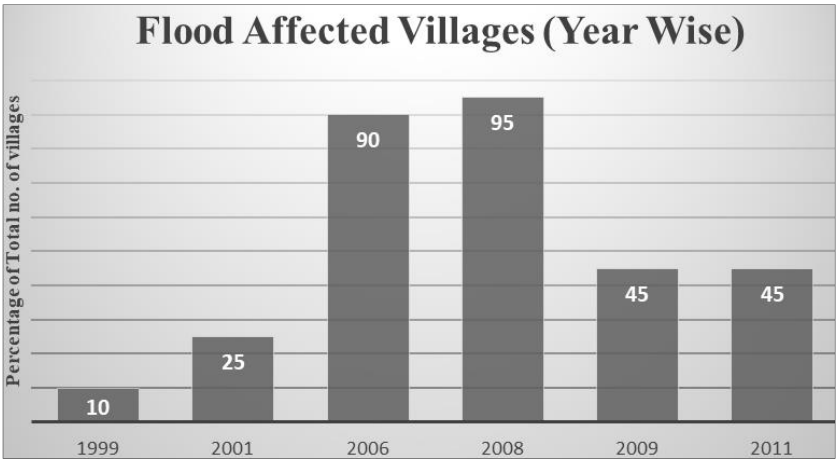
***Source:*** Primary questionnaire survey of house hold, 2017

**Table 4:** List of related extreme climatic events occurred in the study area

| Type of Disaster | Year of Occurrence | Month of Occurrence |
|---|---|---|
| Flood | 1992 | August |
| | 1995 | |
| | 1997 | |
| | 1999 | October |
| | 2001 | July |
| | 2003 | July-August |
| | 2006 | August |
| | 2008 | September |
| | 2009 | September |
| | 2011 | August |
| | 2013 | |
| Cyclone | 1967 | October |
| | 1971 | October |
| | 1982 | August |
| | 1999 | October |
| | 2013 | October |
| | 2014 | October |
| | 2019 | May |
| Heavy Rainfall | 1995 | May |
| Unseasonal Rain | 2010 | December |

***Source:*** Rajnagar Automatic Rain Recording Station

Rajnagar Block is a coastal block in the river mouth of various rivers like the Brahmani, Hansua, Patasala etc. with the increasing frequency of cyclone as a consequence of climate change impacts floods are the permanent feature of this area. During floods most of the villages got affected due to water logging and salinization problems (Fig: 2).




***Source:*** Annual reports on calamities: special relief commissioner revenue & disaster management department

**Fig 2:** Year wise flood affected villages

**Table 5:** Important concerns of respondents about effects of adverse climate impact

| Important Concerns of Respondents about Effects of Adverse Climate Impact | H.H No. | % |
|---|---|---|
| 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 house hold, 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 reduce fresh water availability and Quality. 42 % of respondent perceived their concern about reduced fresh water availability, Health issues, Impacts on agricultural production as the adverse impact of climate change (Table 5).

## Water Dependency & Availability

River Brahmani and Baitarani along with their distributaries from the drainage system in and around the block. 13 GPs are surrounded by distributaries of Brahmani River (Table 6). As 48 percent and 16 percent population of the total respondent were cultivators and agricultural labours the livelihood of coastal community are supposed to highly dependent upon surface water system (Rivers) for agriculture. But due to erratic Rainfall pattern and Sea water intrusion they do not prefer to use River water for agriculture.79 percent of the total households depend on rain water and only 15 percent uses River water for agriculture (Table 7).

**Table 6:** Surface water resource

| Name of the GPs | Name of the Rivers Flowing |
|---|---|
| Rajnagar | Brahamani, Hansua |
| Mahisasura | Hansua |
| Sanabada Gopalpur | Hansua |
| Balisahipatna | Brahamani, Kani |
| Keradagarh | Baitarani, Kani, Hansua |
| Rajpur | Brahamani, |
| Ostia | Brahamani, |
| Belpal | Brahamani, Hansua |
| Bandhapada | Brahamani, Kani |
| Dera | - |
| Hatina | - |
| Brahmansahi | Baruni |
| Kurunti | - |
| Koilipur | Gobari, Luna |

***Source:*** Primary field survey

**Table 7:** Source of water for different usage

| Source of Water | Agriculture | % | Domestic and household use | % | Fisheries | % | Not Dependent | % | Grand Total | % |
|---|---|---|---|---|---|---|---|---|---|---|
| Open well | 0 | 0% | 5 | 6% | 0 | 0% | 80 | 94% | 85 | 100% |
| Pond | 0 | 0% | 30 | 35% | 7 | 8% | 48 | 56% | 85 | 100% |
| Rain water | 67 | 79% | 0 | 0% | 0 | 0% | 18 | 21% | 85 | 100% |
| River | 13 | 15% | 16 | 19% | 6 | 7% | 50 | 59% | 85 | 100% |
| Tube well | 0 | 0% | 84 | 99% | 0 | 0% | 1 | 1% | 85 | 100% |

***Source:*** Primary questionnaire survey of house hold

## 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 % household reported that the water was not clean, 21 percent reported the water was salty (Table 8).

**Table 8:** Household's opinion on tube well water source

| Household's Opinion | Count of Household No. | % |
|---|---|---|
| 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 house hold, 2017

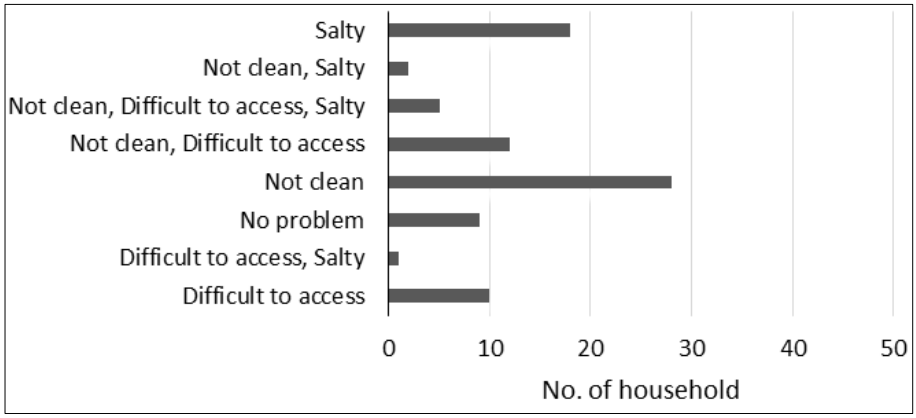



**Fig 3:** Household's opinion on tube well water

## Water quality assessment

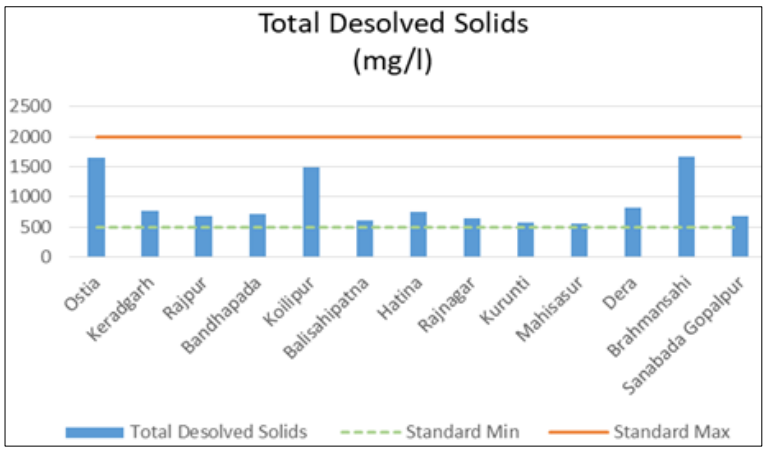
Water is essential to sustain life and a satisfactory (adequate, safe and accessible) supply must be available for all (Guidelines for drinking-water Quality, 2004) [6]. According to the primary survey it has been noticed that community of the study area are being suffered from very low quality of water 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 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.

**Table 9:** General water parameters for quality assessment

| ID | Name of the GPs | Latitude (N) | Longitude (E) | Electronic conductivity | TDS | Turbidity | pH | TH CaCo3 Mg/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 |

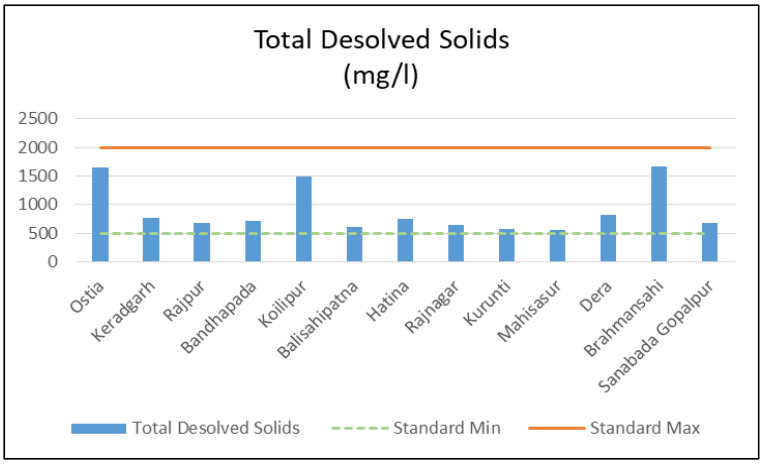
***Source:*** Primary field survey, June, 2017

All the parameters' permissible limits of drinking water are not same for different agencies i.e. USEPA, WHO, IS. The table 8 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 (Fig 4 & 5). It indicates higher salinity level in ground water. High levels of salt concentration in freshwater can cause problems for aquatic ecosystems and human uses.



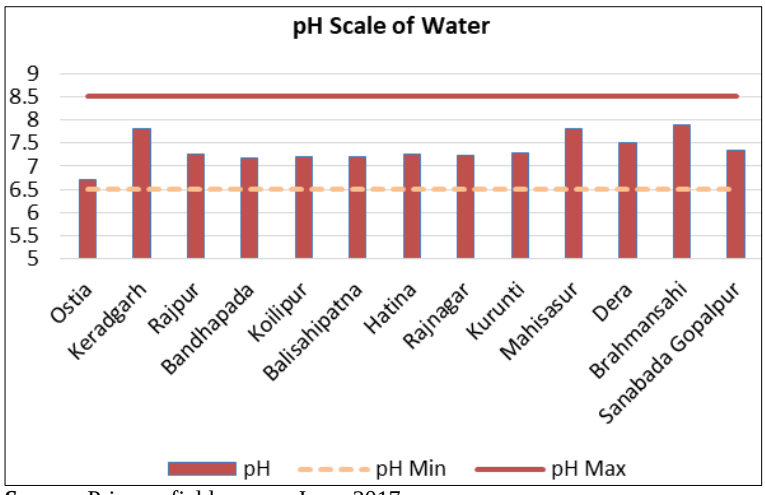

***Source:*** Primary field survey, June, 2017

**Fig 4:** Total dissolved solids




***Source:*** Primary field survey, June, 2017

**Fig 5:** Electrical Conductivity at 25 °C




***Source:*** Primary field survey, June, 2017

**Fig 6:** pH Scale of Water

**Table 10:** 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) |

### Results of water quality assessment

From this study it has been observed that 82% 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% of the respondent the effects of adverse climate impact lies upon 'reduced water availability, health issues and impact on agricultural production' and 22% 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.

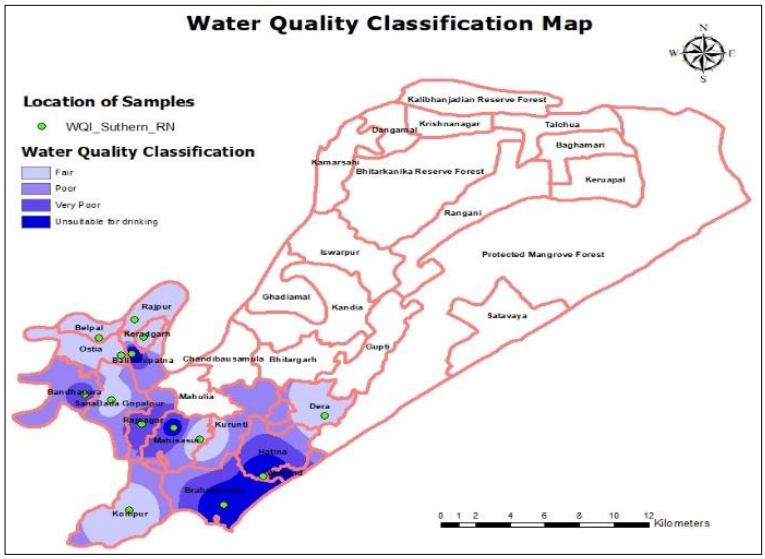



**Fig 7:** Water quality map

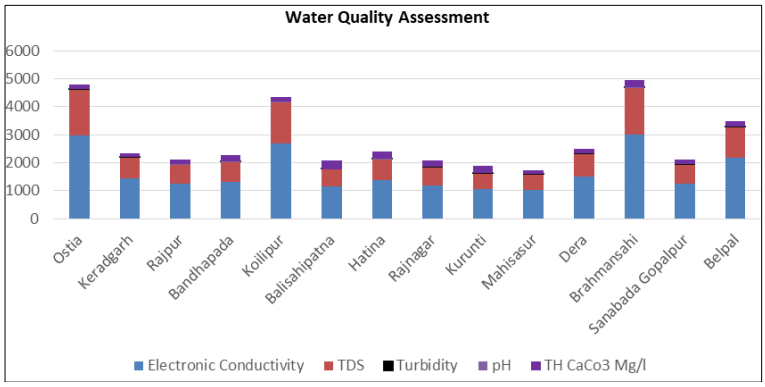



**Fig 8:** Water quality assessment

### Conclusion

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 stakeholder's perception are 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. Involving perception of local respondents often come up with some unique strategical 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.

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