A Micro Level Study on the Environmental Issues of Munroe Island, Kollam, Kerala

[a]Saranya U, [b]T.S.Lancelet

[a]Research Scholar, Dept. of Geography, SSUS, Kalady, India

[b]Professor, Dept. of Geography, SSUS, Kalady, India

Abstract

Once upon a time there was a small island group surrounded by Kallada River and Ashtamudi Lake – a cluster of small 8 islands (called as Thuruths in local Malayalam language). Three sides are embraced by Kallada River and rest one side by Ashtamudi Lake. It had 1000s of small streams used for water transportation and the island was filled with fruits and cultivation of different types. Also the fresh water (absence of salt) helped a lot in the cultivation of paddy fields and aquatic resources too, till Tsunami happened in 2002 which changed the nature of water bodies a lot. People lived with freedom and paddy fields were filled with prawns and fishes.

An environmental problem arises whenever there is a change in the quality or quantity of any environmental factor, which directly or indirectly affects the health and well-being of man in an adverse manner. Mundrothuruth Island, also known as Munroe Island located in Kollam district of Kerala is an island within the Ashtamudi backwater system. The main environmental issues are sinking and shrinking of the island, salt water intrusion, salinity, flooding and human waste disposal. Both primary and secondary data are used to analyze the issue. By analyzing the data and suggest some methods to reduce the issues.

KEYWORDS: Munroe island, sinking, shrinking, salt water intrusion, salinity

An environmental problem arises whenever there is a change in the quality or quantity of any environmental factor, which directly or indirectly affects the health and well-being of man in an adverse manner. Mundrothuruth Island, also known as Munroe Island located in Kollam district of Kerala is an island within the Ashtamudi backwater system. Three sides are embraced by Kallada River and rest one side by Ashtamudi Lake. It had 1000s of small streams used for water transportation and the island was filled with fruits and cultivation of different types. Also the fresh water (absence of salt) helped a lot in the cultivation of paddy fields and aquatic resources too, till Tsunami happened in 2004 which changed the nature of water bodies a lot. People lived with freedom and paddy fields were filled with prawns and fishes.Due to the natural and human interactions results in the changes of environment. This paper clearly examine the different environmental issues and its causes

Objectives

- To identify the major environmental issues
- To examine the reasons and causes for the issues

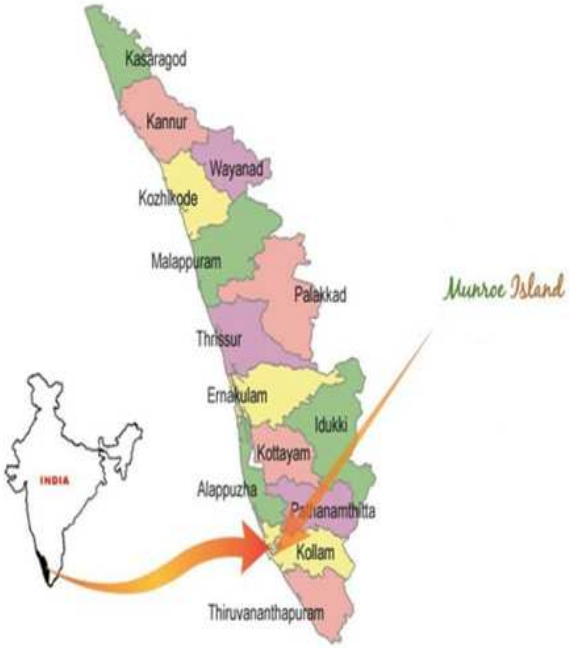
Methods and techniques

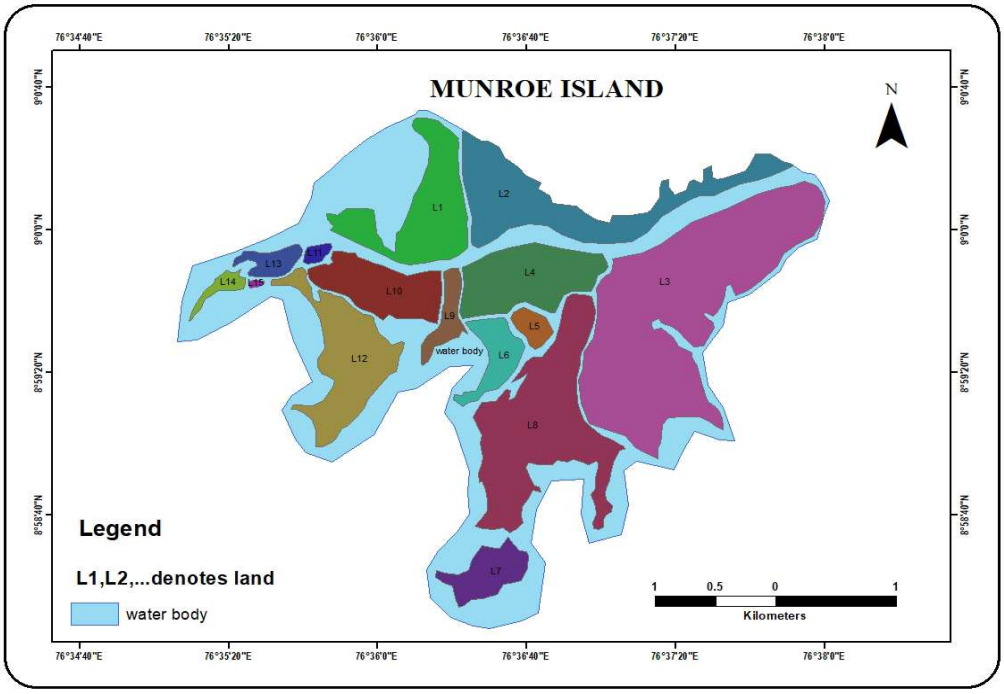
The methods used are primary and secondary data. Primary data include details were obtained through field study, questionnaire, interviews, sampling testing

using scientific method. The secondary form of information includes various governmental, new paper, study reports.

Study area

Munroe Island in Kollam district is an island within the Ashtamudi backwater system and is located at the confluence of Ashtamudi Lake and the Kallada River, in Kollam district of south Kerala, India. The place is named in honour of Resident Colonel John Munroe of the farmer princely state of Travancore. During his tenure Munroe oversaw the land reclamation efforts in delta where Kallada River joins Ashtamudi Lake and the reclaimed island was name after him as Munroe Island. It is a typical backwater island village of Kerala Munroe Island has a geographical area of 13.4sq.km. The island extends from 9 ^{0} 0’0’’ N to 76 ^{0} 35’0’’ E to 9 ^{0} 0’0’’ N to 76 ^{0} 40’0’’E.Mundrothuruth Panchayat is under the Chittumala Block division in the Kollam Taluk of Kerala state consisting of 12 wards. As per 2011, Mundrothuruth has a total population of 9599, consisting of 4636 males and 4963 females.





Source: Toposheet 1975

Results and discussion

The findings obtained through the analysis are discussed below.

The major environmental problems identified in the area are:

1. Sinking,Shrinking, Salt Water Intrusion and Salinity
2. Flooding
3. Human and Other Waste Disposal

1.1. Sinking, Shrinking, Salt Water Intrusion and Salinity

Due to different natural and anthropogenic activities, the island is under sinking and shrinking. The actual elevation of the island is 3m above mean sea level.Due to the 2004 tsunami, the island is dipped to .5 to 1m. Also the sand mining and heavy constructions leads to sinking. The total area of the island is 15.2 km^2 and now it is reduced to 13.4 km^2. One island in the Panchayat is sinked. Shrinkage is also identified, in relation with sinking.

The shrinking of tiny islands, ranging from one acre to over one hectare, was inhabited by humans. But now people were leaving these tiny islands as they find it very difficult to survive here as saline water has invaded the localities. The shrinking of the island is associated with the process of sinking.

The villagers are divided in their opinion on the reasons for the current situation. While some dedicate it to the tsunami in 2004, some others think it is largely man-made. *Environmental activist V.K. Madhusoodanan holds global warming responsible for at least 30 percent of the change. Yet another anthropogenic reason, he points out, could be the delta destabilization. Construction of the Kallada*

dam three decades ago, destruction of mangroves, continuous vibrations caused by the trains that pass by the island are other reasons the activist attributes to the sinking of the island.

The second biggest victims of sea-level rise after oceanic islands are such deltas, he notes. *"Compared to oceanic islands, the population density of delta islands is high. So, it demands massive rehabilitation projects to help these people out. We are working on it now," he adds.* This situation can be resolved by planting mangroves and rehabilitating people, he adds.

Sand mining is presently conducted in the Kallada River zone and along the northern shore of Ashtamudi lake. The sand mining activity will lead to deepening of the riverbed, which will reduce the natural filtering capacity of river. In addition it will increase the rate of bank erosion and saline water intrusion. The present rate of mining of the eastern lake may not be sustainable due to a lack of sediment output from the Kallada River. The estuary is primarily infilling from the sea. The entrance and western portion of the Ashtamudi Lake is shallow and sand rich.

A pristine island and a popular tourist destination, it is undergoing a dramatic change today. Such incidents are common place in Munroe Island which was, until a decade ago, a bucolic isle at the confluence of the Ashtamudi Lake and the Kallada River. Blame it on the tsunami that struck a portion of the world in December 2004, or the inexplicable jinx that seems to have fallen on it, Munroe began to get submerged slowly. More than 150 families have left the island, leaving behind those who have no choice but to stay (news report).

A central team (Centre for Science and Environment (CSE) New Delhi) visited Munroethruthu said that the phenomenon was due to change in climatic conditions caused by global warming and unscientific construction. The team found the water level had risen in the Ashtamudi Lake that surrounds the islands, immersing them partially. This is due to the rise in sea level caused by global warming, the study said

A scientist from Kollam, Sainudeen Pattazhi, based on a field study, concluded that the post-tsunami tectonic shift and dam construction that affect delta formation were the reasons for the sinking which would make Munroe islands disappear in a short period of time.

"In a recent phenomenon, Munroethuruthu was flooded during the high tide which denotes the axial lowering of the land mass. It is not due to climate change, specifically the global warming as assessed," Mr Sainudeen Pattazhi

The study found that some areas, which were situated as high as three meters above the water level before the tsunami, had sunk by .5 to 1 meter. This dip is due to the downward movement of minor tectonic plates in the area caused by the tsunami, according to Mr. Sainudeen. He also said that dam construction along the upstream of Kallada River had also contributed to the phenomenon.

"We need advice and assistance from global conservation organizations like IUCN to protect these islands from impact of global warming," said former Rajya Sabha M P K N Balagopal, who had taken up the issue with the Union government

and environmental organizations like Centre for Science and Environment (CSE) in New Delhi.

"Sea levels set to rise far more rapidly than expected. So we need aid from center and global conservation organizations to save the sinking islands," he said.

Balagopal suggested utilizing a part of the Green Climate Fund, sponsored by United Nations Framework Convention on Climate Change for developing countries, to help the islands to deal with sea level rise.

The Kerala Sasthra Sahitya Parishad conducted a study and found that Munroethuruthu was sinking because of the rise in water level due to global warming or the tectonic movement,

The study said that the silt accumulation in Munroethuruthu had dropped to over 95 percent because of the construction of the dam at Thenmala, the upstream of Kallada River. The tsunami tremors might have also affected the islands, besides the vibrations of train service on the fragile delta. Mangroves were also extensively destroyed in these areas. "It is human activities, rather than global warming, that make these islands sink in the lake faster," the study said.

Saltwater intrusion is the movement of saline water into freshwater aquifers, which can lead to contamination of drinking water sources and other consequences. Saltwater intrusion occurs naturally to some degree in most coastal aquifers, owing to the hydraulic connection between groundwater and seawater. Because saltwater has a higher mineral content than freshwater, it is denser and has a higher water pressure. As a result, saltwater can push inland beneath the freshwater. Other contributors to saltwater intrusion include navigation channels or agricultural and drainage channels, which provide conduits for saltwater to move inland, and sea level rise.

Salinity is the accumulation of salt in soil and water. High salt levels can adversely affect plant growth, soil structure, water quality and infrastructure.

"Fish Adapt -Global Conference on 'Climate Change Adaptation for Fisheries and Aquaculture" that took place in Banghok from 8 to 10 August 2016. Sinking islands are an issue mostly due to rising sea levels, which fall under climate change. However, what makes Munroe Island different is that it is not in the ocean with tides etc., it is in the backwaters where tides are generally not an issue. In this seminar, there is a discussion was conducted about the environmental issues.

The largest river island Majuli in Assam is submerging due to excessive sediment discharge caused by frequent low magnitude seismic disturbances. It has been reported that the surface area of the island has been reduced from 1,100 square kilometers to 352 square kilometers within a short span of time.

There is a history of islands sinking. Lohachara, which was finally lost in 2006, marks one such history. This was the first inhabited island to be submerged as a result of climate change and was located in India's Sundarbans, where the rivers Brahmaputra and Ganges empty their contents into the Bay of Bengal. The island was once inhabited by as many as 10,000 people. As it gradually sunk into the sea, most of the residents fled to the neighboring Sagar Island, which is also under threat of sinking.

The salinity of the island can be analyzed with the help of sample testing. The following table shows the water quality testing result of 24 samples taken from the island regions, Ashtamudi Lake and Kallada River.

Testing Results

The result of sample test obtained through APHA (American Public Health Association) method based on Bureau of Indian Standards is given below.

Vulnerability Assesment of water pollution in Munroe Island, Kollam										
Parameters	Sample Code									
	MI G1	MI G2	MI G3	MI G4	MI G5	MI G6	MI G7	MI G8	MI G9	MI G10
pH	5.25	5.05	6.48	4.97	5.94	4.54	6.12	6.1	5.98	5.38
Temperature (°c)	28.1	28.5	29.3	28.8	29.6	29.6	28.7	28.5	30.2	28.3
Electrical Conductivity(us/cm)	207	385	220	181.5	230	302	1265	662	244	280
Total Dissolved Solids (mg/l)	147	273	157	129	163	214	896	470	173	207
Salinity (ppt)	0.11	0.2	0.12	0.1	0.12	0.16	0.67	0.34	0.13	0.15
Total Hardness (mg/l)	23.52	15.68	35.28	19.6	54.88	78.4	203.84	148.96	74.48	50.96
Total Alkalinity (mg/l)	4.12	4.12	37.08	8.24	24.72	8.24	24.72	45.32	32.96	12.36
Chlorides (mg/l)	38.29	93.59	29.78	29.78	38.29	76.57	382.86	144.64	42.54	72.32
Sulphates (mg/l)	7.12	3.64	10.72	21.2	15.52	2.64	44.48	58.88	28.24	17.8
Nitrate (mg/l)	19.98	31.19	22.28	4.92	20.29	26.8	3.99	11.08	3.99	2.17
Phosphate (mg/l)	0.18	0.12	0.03	0.06	0.09	0.06	0.06	0.03	0.03	0.03
Calcium mg/l	6.27	4.7	6.27	6.27	1.57	9.41	45.47	43.9	28.22	18.81
Magnecium (mg/l)	1.9	0.95	4.76	0.95	12.38	13.33	21.9	9.52	0.95	0.95
Sodium (mg/l)	21.4	60.44	14.19	16.96	16.69	35.19	160.48	61.8	17.84	31.48
Pottassium (mg/l)	4.92	0.72	8.1	8.79	7.94	3.53	2.72	6.16	1.74	2.35
Iron (mg/l)	BDL	0.06	BDL	BDL	0.01	BDL	0.12	BDL	BDL	BDL
Total Coliform (MPN/100ml)	28	≥2400	≥2400	≥2400	≥2400	20	≥2400	≥2400	≥2400	≥2400
E coli	P	A	P	P	P	A	P	P	A	A

Source: Sample Survey

Parameters	Sample Code Kalladayar			
	MI K1	*MI K2*	*MI K3*	*MI K4*
pH	6.72	7.34	6.87	6.95
Temperature (°c)	30.8	30.3	3.27	30.4
Electrical Conductivity (us/cm)	2230	4700	3270	2500
Total Dissolved Solids (mg/l)	1580	3310	2310	1780
Salinity (ppt)	1.21	2.66	1.81	1.38
Total Hardness (mg/l)	239.12	474.32	372.40	262.64
Total Alkalinity (mg/l)	16.48	20.60	12.36	12.36
Chlorides (mg/l)	1612.27	1654.81	1144.33	889.09
Sulphates (mg/l)	249.2	194	154	106.80
Nitrate (mg/l)	0.62	1.64	0.75	0.22
Phosphate (mg/l)	0.06	0.03	BDL	0.09
Calcium (mg/l)	21.95	32.93	26.66	20.38
Magnecium (mg/l)	44.77	95.26	74.30	51.44
Sodium (mg/l)	326.48	725.80	520	392.50
Pottassium (mg/l)	15.84	29.60	21.40	17.30
Iron (mg/l)	0.17	BDL	BDL	0.31
Ammonium (mg/l)	0.19	0.17	0.30	0.37
DO (mg/l)	6.533	5.53	6.33	6
BOD (mg/l)	1.53	1.07	2.93	1.40
COD (mg/l)	80.92	147.14	176.56	448.76
Total Coliform (MPN/100ml)	≥2400	150	150	≥2400
Ecoli	P	P	P	P

Source: Sample Survey

Parameters	Sample Code Ashtamudi					
	MI A1	***MI A2***	***MI A3***	***MI A4***	MI A5	MI A6
pH	8.08	6.94	7.30	8.35	7.17	7.04
Temperature (°c)	32.1	30.9	30.9	32.3	32.1	31.3
Electrical Conductivity (us/cm)	16700	5550	7240	14400	4450	3200
Total Dissolved Solids (mg/l)	16300	3910	5140	10500	3150	2570
Salinity (ppt)	9.92	3.17	4.27	8.90	2.54	2.03
Total Hardness (mg/l)	4468.80	823.20	1097.60	2548	588	431.20
Total Alkalinity (mg/l)	32.96	24.72	37.08	53.56	65.92	24.72
Chlorides (mg/l)	13836	4756	6596	17196	2756	3436
Sulphates (mg/l)	1840	282	445.60	1094	199.60	143.60
Nitrate (mg/l)	3.10	0.4	2.7	2.57	0.66	0.62
Phosphate (mg/l)	0.03	0.03	BDL	BDL	BDL	BDL
Calcium (mg/l)	313.60	78.40	94.08	156.80	78.40	31.36
Magnecium (mg/l)	895.41	152.41	209.56	523.91	95.26	85.73
Sodium (mg/l)	7306	1494.40	1606.80	3853	761.20	593.60
Pottassium (mg/l)	294	302	66.40	156	30.40	24
Iron (mg/l)	BDL	BDL	0.02	BDL	BDL	BDL
Ammonium (mg/l)	0.15	0.23	0.40	0.24	0.24	0.33
DO (mg/l)	6.93	4.80	5.93	7.93	6.27	5.33
BOD (mg/l)	4.80	1.40	3.13	4.60	2.60	2.80
COD (mg/l)	88.28	111.19	263.33	1000.65	158	26.33
Total Coliform (MPN/100ml)	28	39	≥2400	150	≥2400	120
Ecoli	P	P	P	P	P	P

Source: Sample Survey

Parameters	Sample Code of Farm			
	MI F1	*MI F2*	*MI F3*	*MI F4*
pH	6.59	8.2	7.41	6.99
Temperature (°c)	32.1	33.2	33.1	34.1
Electrical Conductivity (us/cm)	9050	19600	15800	17220
Total Dissolved Solids (mg/l)	6370	15600	10500	11600
Salinity (ppt)	5.38	16.9	9.92	12.2
Total Hardness (mg/l)	666.4	1646.4	6370	5782
Total Alkalinity (mg/l)	20.60	82.40	65.92	8.24
Chlorides (mg/l)	4462.45	11587.9	8078.35	8291.05
Sulphates (mg/l)	606.40	1736	1202	1170
Nitrate (mg/l)	0.22	2.66	1.46	1.68
Phosphate (mg/l)	0.03	BDL	BDL	BDL
Calcium (mg/l)	156.80	156.80	1960	392
Magnecium (mg/l)	66.68	304.82	357.21	1166.89
Sodium (mg/l)	2261	6048	3759	4412
Pottassium (mg/l)	96	248	144	193
Iron (mg/l)	BDL	BDL	BDL	BDL
Ammonium (mg/l)	0.26	0.19	0.45	0.35
DO (mg/l)	5.87	11.60	7.87	6.47
BOD (mg/l)	2.80	9.67	5.87	4.87
COD (mg/l)	36.78	1469.34	1628.19	662.11
Total Coliform (MPN/100ml)	≥2400	28	150	150
Ecoli	P	P	P	P

Source: Sample Survey

The samples from MI G1 to MI G6, the salinity is normal, but the sample MI G7 the amount of salinity is high (o.67ppt). The samples MI G8 to MI G10 the salinity result is normal. These 10 samples are selected from within the island (see apendix4).

The samples MI k1 to MI K4 collected from the Kallada river shows that the salinity is high. In sample MI K1 the salinity is 1.21ppt, followed by 2.66ppt in MI K2, 1.81ppt in MI K3 and 1.38ppt in sample MI K4.

Samples drawn from in and around the Ashtamudi Lake also show salinity in a massive amount than the normal. There are 6 samples are collected from this area. The sample MI A1 shows the salinity of 9.92ppt which is the highest amount the 6 samples followed by 8.90ppt by MI A4, 4.27ppt by MI A3, 3.17ppt by MI A2, 2.54ppy by MI A5 and 2.03 by MI A6.

About 4 samples are from the shrimp farms located in the island. Those samples show high salinity. The sample MI F2 shows high salinity among the other samples (16.9ppt). The salinity of MI F4 is 12.2ppt, 9.92ppt by MI F3 and 5.38ppt by MI F1.

Out of the total 24 samples 15 samples shows high salinity. The high amount of salinity in the samples which is collected from the Kallada River, Ashtamudi Lake and shrimp farms leads to some serious problems. They are the increasing amount of salinity leads to the cultivation of paddy is not possible and the shrimps in the farms are reduced. The high saline content is not good for the agricultural and aqua culture activities. The chemicals resent in the solution cause damage to the buildings. The salinity result shows that, there the salt water intrusion is high. Most of the water logged regions are under this phenomena.

1.2. Flooding

A flood is an overflow of water that submerges land which is usually dry. The European Union (EU) Floods Directive defines a flood as a covering by water of land not normally covered by water. In the sense of ‘flowing water’, the word may also be applied to the inflow of the tide. To analyze the flooding in Munroe Island, selected the tidal data of Kollam (Expert Committee Report (2015)).

Before Tsunami the island was affected by tides only in two times. But after Tsunami, the tidal flooding occurs 8 times in a year and the water remains there for weeks.The island is the victim of global warming.Tides are the rise and fall of sea levels caused by the combined effects of the gravitational forces exerted by the moon and the sun and the rotation of the earth.

The National Centre for Earth Science Studies (NCESS), Kerala State Council for Science, Technology and Environment (KSCSTE) and the State Disaster Management Authority (SDMA) inferred that the flooding is caused by spring tide or subsidence (Spring Tide Theory).

The times and amplitude of tides at a locale are influenced by the alignment of the sun and moon by the pattern of tides in the deep ocean, by the amphidromic systems of the oceans, and the shape of the coastline and near shore bathymetry. Some shorelines experience a semi - diurnal tide-two nearly equal high and low tides each day. Other locations experience a diurnal tide – only one high and low tide each day. A “mixed tide”; two uneven tides a day, or one high and one low, is also possible.

Tides vary on timescales ranging from hours to years due to number of factors. To make accurate records, tide gauges at fixed stations measure the water level over time. Gauges ignore variations caused by waves with periods shorter than minutes. These data are compared to the reference (or datum) level usually called mean sea level.

Tidal phenomena are not limited to the oceans, but can occur in other systems whenever a gravitational field that varies in time and space is present.

Tide changes proceed via the following steps:

- Sea level rises over several hours, covering inter tidal zone; flood tide.
- The water rises to its highest level, reaching high tide.
- Sea level falls over several hours, revealing inter tidal zone; ebb tide.
- The water stops falling, reaching low tide.

A tidal coefficient is a system primarily used in France and therefore featured in many French pilot books, web sites and harbor notices. It's a tabular system that depicts the 'size' or 'magnitude' of the expected tide at a simple glance. It eliminates the need of having to look up and calculate the range of tides and the need to determine whether its neaps or springs or anywhere in between. The coefficients usually range from anywhere between 20 and 120 and a good typical guide to use is:

20 – Very small neap

45 – Mean neap

70 – Average tide

95 – Mean spring

120 – Very big spring

The following table shows that the high and low tidal coefficient (average). The high tidal coefficient varies from 93 to 116 within 30 days and the low tidal coefficient varies from 36 to 41 within a month. This shows that almost all the day the island is affected by flood. These values give us a rough idea of the tidal amplitude in Kollam, forecast in August. Large coefficients indicate important high and low tides; major currents and movements usually take place on the sea bed. But bear in mind that this tidal amplitude may be greatly affected by the weather.

Table 1.1 (a): KOLLAM – TIDAL COEFFICIENT

Sl.No	Year	Month	Date	High tidal coefficient (avg.)	Low tidal coefficient (avg.)
1	2015	Sep	1/9/2015-30/9/2015	116	41
2	2015	Oct	1/10/2015-31/10/2015	112	41
3	2015	Nov	1/11/2015-30/11/2015	103	41
4	2015	Dec	1/12/2015-31/12/2015	93	42
5	2016	Jan	1/1/2016-31/1/2016	93	41
6	2016	Feb	1/2/2016-29/2/2016	106	39
7	2016	March	1/3/2016-31/3/2016	114	36

8	2016	April	1/4/2016-30/4/2016	115	43
9	2016	May	1/5/2016-31/5/2016	110	46
10	2016	June	1/6/2016-30/6/2016	100	46
11	2016	July	1/7/2016-31/7/2016	93	43
12	2016	August	1/8/2016-31/8/2016	101	39

Source: http://www.tides4fishing.com/as/india/kollam

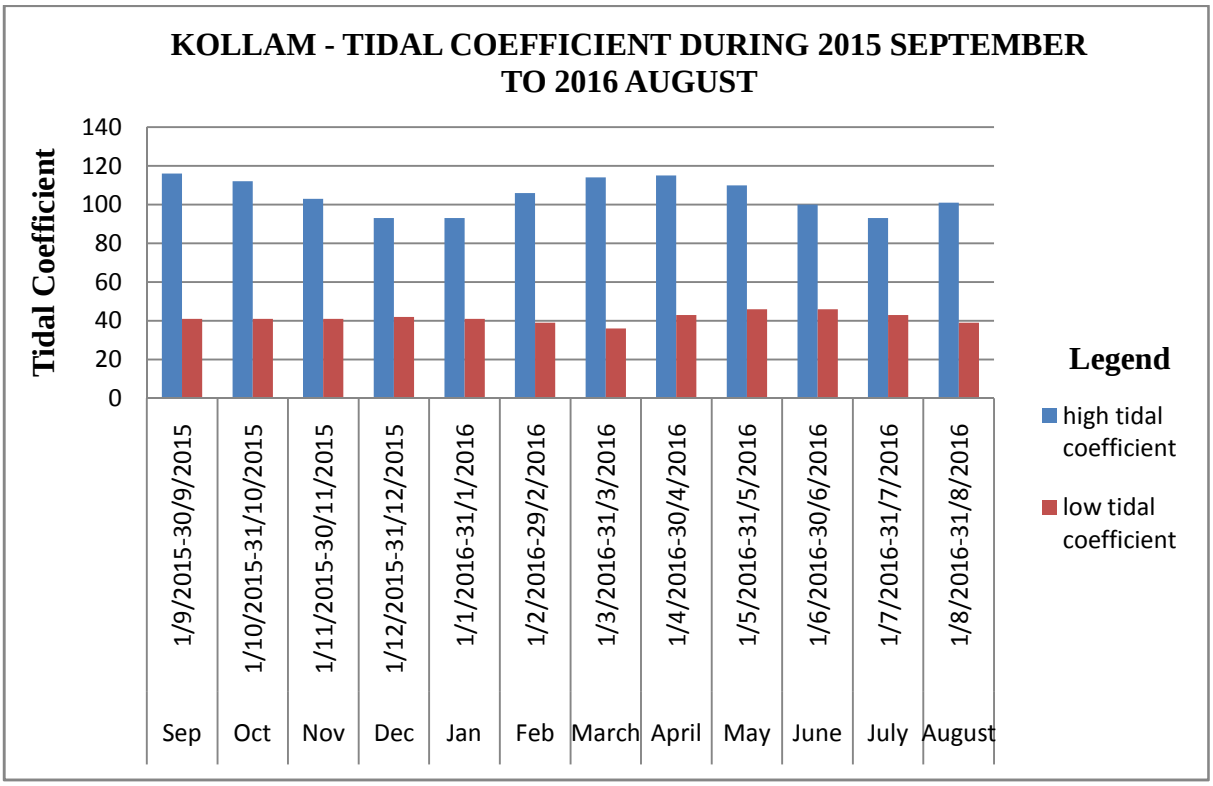


Figure 1.1 (a)

The following table shows the average monthly tidal chart during September 2015 to august 2016 of Kollam. This table shows that the coefficient is very high in the month of January (2015) that is 104 and the height of the tide is varies from 0.2 m to 1.0 m. A high coefficient of 80 to 89 is experienced in October (2015, June, July and August (2016). In these months the height of the tide is varies from 0.2 m to 0.9 m. In November, December (2015) and May (2016), the tidal coefficient experienced is middle and the values ranges from 53 to 58. The height of the tides varies from 0.4m to 1.0 m. very low coefficient ranges from 39 to 46 is experienced with height of tides ranges from 0.04 to 0.9 m in January (2016) to April (2016).

The island is under flooding condition because the height of the island is varies from 2 to 3 m above the mean sea level. Due to various environmental and naturalphenomena the height of the island is reduced to .5 to 1m in the water logged regions. The heights of the tides are varies from 0.2 to 1m so that directly allow the water to enter in to the land and remains for hours. This is a serious issues and it unswervingly affect the settlement, cultivation and other developmental activities. Due to this issue many family abandoned their house and that will discussed in the following chapters.

The flooding of Munroethruthu happened post-tsunami. Sundarbans and the Kutch region experienced flooding due to global warming. Similar effects of global warming were found in Ashtamudi Lake. The deltas and islands are more exposed to the threat of global warming and Munroethruthu is a delta of Kallada river," Mr. V.K. Madhusoodanan, environment activist

The flood water due to tides had entered in to the land and even inside the buildings including dwelling units. The flooding was severe during the recent tides associated with swell waves. In Munroe Island the impact due to swell waves associated with the tides was more severe as many structures which had settled during last few years in the area were flooded. The Panchayat had reported that 150 families are affected.

"We are used to this now--cooking, cleaning, doing everything in ankle-high water," says Rajan's wife Achamma nonchalantly.

Table 1.1 (b): KOLLAM – AVERAGE MONTHLY TIDAL CHART DURING SEPTEMBER 2015 TO AUGUST 2016

Date		1st tide	2nd tide	3rd tide	4th tide	Coefficient
2015 September	Time	2.30 h	8.15h	14.30h	20.30h	104 (very high)
	Height	1.0 m	0.2m	0.9h	0.1m	
2015 October	Time	2.40 h	8.35 h	14.40 h	20.35 h	89 (high)
	Height	1.0 m	0.2 m	0.9 m	0.2 m	
2015 November	Time	3.20 h	9.30 h	15.30 h	21.10 h	58 (middle)
	Height	1.0 m	0.4 m	0.8 m	0.4 m	
2015 December	Time	3.35 h	9.55 m	16.10 h	21.20 h	53 (middle)
	Height	1.0 m	0.4 m	0.9 m	0.5 m	
2016 January	Time	4.30 h	10.30 h	17.35 m	22.20 h	46 (low)
	Height	1.0 m	0.5 m	0.9m	0.6 m	
2016 February	Time	4.55 h	10.55 h	18.40 h	23.30 h	39 (low)
	Height	0.9 m	0.5 m	0.9 m	0.6 m	
2016 March	Time	4.20 h	10.15 h	17.30 h	22.55 h	40 (low)
	Height	0.9 m	0.04m	0.9 m	0.6 m	
2016 April	Time	4.10 h	11.10 h	19.20 h	_	43 (low)
	Height	0.7 m	0.5 m	0.8 m	_	
2016 May	Time	.50 h	8.50 h	13.10 h	20.45 h	57 (middle)
	Height	0.5 m	0.7 m	0.5 m	0.8 m	
2016 June	Time	3.00 h	10.40 h	16.30 h	22.25 h	80 (high)
	Height	0.3 m	0.8 m	0.4 m	0.7 m	
2016 July	Time	3.25 h	11.00 h	17.10 h	22.50	80 (high)

					m	
	Height	0.3 m	0.8 m	0.4 m	0.7 m	
2016 August	Time	5.25 h	12.20 h	18.35 h	_	86 (high)
	Height	0.3 m	0.9 m	0.3 m	_	

Source: http://www.tides4fishing.com/as/india/kollam

"Prior to tsunami, the effects of high tide were severe only in the month of Vrishchikam (November-December) during the full moon. But now high tide can be expected anytime, sometimes once or twice a week, sometimes more. The worst we had was when the water level raised ankle high and remained that way for more than two weeks". A major portion of the Munroe Island has washed away in high tides. The most affected are Kidapram North and South, Kandramkani, Pattamthuruth East and West and Nenmeni. Around 300 families are stranded as some area of the land is getting eroded.

1.3. Human and other solid waste disposal

Problems and issues are occurred due to physical, human and biological factors. Like other parts of areas in the world, this island also faces the waste disposal activities. Those waste disposals are in the form of human and solid substances. This leads to series issues. The sample test (24) results shows that all the water in and around the island are contaminated with the presence of some harmful chemical and biological contaminators. That completely affects the health of the people.

There are about 24 samples are collected to analyze the water quality and salinity of the island. In those 20 samples shows the presence of bacteriological contaminators that is total coliform and e coli (see appendix 4). The presence of these bacteria seriously affects the health conditions and results ingastrointestinal illness. Mainly these bacteria are released from the digestive tracts of animals, including humans, and are found in their wastes.

Chemicals or other substances which are released from the disposal of remains of plastic or other non-biodegradable items in to the soil and water results solid wastes. That leads to some series general and health issues. The chemical parameters identified are chloride, sulphate, nitrate, phosphate, calcium, magnesium, sodium, potassium, iron, and ammonium (sample result and limit are in appendix 4).The presence of sodium and potassium in water leads to some health issues. Potassium toxicity has been studied in relation to the use of high doses of salt substitutes. The symptoms have been chest tightness, nausea and vomiting, diarrhea, hyperkalemia, shortness of breath and heart failure (WHO, 2009).Undesirable effect outside the acceptable limit of Total Hardness leads to encrustation in water supply structure and adverse effects on domestic use, presence of Chloride leads to high blood pressure, skin irritation and boiled meat and food become poor in quality, salty taste. Sulphate presence leads to taste and laxative affected and gastro intestinal irritation. The Nitrate in high amount leads to methemoglobinemia or blue baby disease in infants. Phosphate leads to algal growth. Excess limit of calcium results in encrustation in water supply structure and adverse effects on domestic use. Magnesium leads to poor lathering and deterioration of clothes. Presence of ammonia indicates pollution and growth of algae.

Conclusion

The issues such as sinking, shrinking, salinity and saltwater intrusion are high in this area.These issues directly and indirectly affect the day to day life of the islanders in various ways. These parameters are analyzed on the basis of so many study reports by various experts from departments. Flooding occurs frequently in Munroe Island. The samples that are collected for analyzing the quality show the presence of some chemical and biological contaminators which are harmful for the human health. Dueto these environmental issues, the islanders which are concentrated on the water logged regions abandoned their home.

References

Book reference

- Siddique (2012), Environmental Problems in 21st Century, Signature Books International, Delhi.

Journal reference

- Berringer Andrea C.S, (2011), Climate Change And Emigration: Comparing "Sinking Islands" And Jamaica,Miradas En Movimiento Special Vol. January 2012: (125-141).
- C. Shakir, A. Manilal, M. Jayakumar, S. Sujith, J. Selvan, (2010), Current Status of Shrimp Farms in the South Western Coast (Manroe Island, Kollam) India, Iranical Journal of Energy and Environment 1(4):287 – 292,2010, ISSN 2079-2115.
- HazraSugata, GhoshTuhin, DasGupta Rajashree and SenGautam (2002),Sea Level and associated changes in the Sundarbans,Science and Culture (ISSN 0036-8156), Vol 68, no 9-12, , p 309-321
- Sasidharan. C.K, Sivanandan P,Ecotourism for Inclusive Growth: A Case Study of Ashtamudi Lake.
- Sitaram Nagaraj,Impact of Urbanization on Water Quality Parameters – A Case Study of Ashtamudi Lake Kollam, IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308, Volume: 03, Special Issue: 06, May-2014.
- BIS (1991), Indian Standard Specification for Drinking Water, Bureau of Indian Standards, New Delhi.

Reports

- An expert team from the Thangal Kunju Musaliar College of Engineering, Kollam. The team headed by Prof. Gouri Antharjanam, and consisting of Prof. Suniil Kumar, Prof. Sirajudeen, Prof. Sruthi. R. Krishnan, Prof. Amal Azad and Prof. Udayakumar
- BIS (1991), Indian Standard Specification for Drinking Water, Bureau of Indian Standards, New Delhi.

- Census report 2001 and 2011
- Central team study on Munroe Island's Environmental Issues byCentre for Science and Environment (CSE) New Delhi.
- Fish Adapt -Global Conference on 'Climate Change Adaptation for Fisheries and Aquaculture" in Bangkok from 8 to 10 August 2016
- Panchayat level statistics -2011, Kollam district
- The Kerala Sasthra Sahitya Parishad study on Munroe Island- Environmental Issues.
- Visit to Vembanad Kol, Kerala, a wetland included under the National Wetland Conservation and Management Programme of the Ministry of Environment and Forests, 2008

Newspaper and magazines

- ✓ Expert Committee Report 2015 on Mundrothuruth Island Environmental Issues by Kerala State Council For Science Technology And Environment
- ✓ Madhyamam weekly, volume 19, 2016 February 22.
- ✓ Neelima Parvathi, Posted By : Sabita kaushal, Posted Date : Thu, 2016-08-11 13:40
- ✓ Study on Land Erosion in Munroe Island Urged, Express news service/ publishes:16 Oct 2014
- ✓ TKM starts study on Munroe Island, The Hindu Dated 6-01-2016 Of lives bruised by water

Web References

- ❖ http://tides4fishing/as/india/kollam
- ❖ https://en.m.wikipedia.org>wiki>Mundrothuruth
- ❖ http://wqaa.gov.in
- ❖ www.ecostat.kerala.gov.in
- ❖ www.goodreads.com/quotes/tag/island
- ❖ www.nios.ac.in/media/documents/316courseE/ch29.pdf)
- ❖ www.weather2travel.com