Chapter - 3

Beach Quality Index (BQI) for Coastal Destinations with Application of Geospatial Techniques

3.1 Beach Quality: An issue in the study area

The shorefront beach-water stretch is the main attractive place for the tourists. In the holidays, people are coming at the coastal zone, in some specific destination sites and spent their quality times with leisure and recreational activities. The tourist spots are remained somehow less disturbed during the off season. But, during the peak season a large number (mass) of people are gathered within the fixed area creating a huge pressure in the coastal landscape settings. The destructive activities like (excessive consumption of water and energy, destruction of flora and fauna, deforestation, increasing solid waste) by the tourists are paid to the coastal landscape, natural ecosystem and biodiversity of the entire area. Therefore, the coastal stretch gradually deteriorates its natural environmental quality. Moreover, the wastes made by the mass people in the tourist spots in form of biodegradable, non-degradable and other solid wastes are accumulated in cumulative ways in day by day. These wastes are also creating threats to the bio-physical environment of the coastal areas. The tourists are facing a degraded coastal stretch which is already deteriorated its physical, environmental, biological and bio-physical quality. Therefore, the health status and level of recreation of the tourists are affected (Gossling, 2002). To protect the coastal environment and provide a safe environment for the tourists and other coastal people there have need to control and manage the landscape degradation and bio-physical wastes. Then the threats will minimize and the potential coastal ecotourism introduce in any of the existing and new sites. Therefore, it is important to monitor the beach management and improve the quality of the beaches for the coastal tourists. Moreover, it can provide the services and other facilities to the coastal tourists by ensuring their health and comfort without damaging the natural resources of the coastal area.

3.2 Degradation of Beach Quality

The beach quality over the selective tourist sites of Mandarmani (A), Dadanpatrabar (B), Dakshinpurosuttampur (C), Rasulpur (D), Mandirtala (E), Boatkhali (F), Beguakhali (G), Gangasagar (H), Frejerganj (I), Bakkhali (J) and Henry's Island (K) are mostly affected due to the increasing pressure of the tourists. [Note: The BQI is not calculated for Nayachar Island and Benubon as they are not beach fringed sites in the coastal destinations].The coastal environment is sensitive and susceptible to the natural and anthropogenic threats which have direct impact on coastal environment, health and wellbeing of the tourists. Therefore, need to take necessary actions to monitor the beach erosion, pollution and lowering for controlling the beach quality in the tourism sites.

3. 3 Requirement of Beach Quality Assessment

The beaches of the coastal area are composed of fine sand and silt. The sandy beach is preferred by the tourists for lead dissolved material in the water which makes more transparent water in the shorefront areas. Tourists are more active in that shorefront beach section, in between the high and low tide level. The coastal resources and beaches are the important part for the tourist that attracts the local as well as the foreign tourists emphasizing the potentiality of the coastal destinations. Therefore, to evaluate the ecotourism potentiality of the area, it is important to assess the beach quality of the studied beaches. The sun-sea-sand (3S) concept is a major contributor to the world economy as coastal tourism plays an important role in the economic sectors of the national tourism market (European Commission, 2014). Therefore, the tourist destination landscape maintenance is necessary to providing a healthy environment for the nature tourism as well as mass tourism in to some extent to closely familiarize with the coastal life and experience the comfort. It is also important to maintain the beach quality and the sustainable management of the marine resources and protect the coastal ecosystem. However, it is possible only under the framework of ecotourism infrastructure development in the coastal tourist's destination sites (Ritchie and Crouch, 2003; Jedrzejczak, 2004). Therefore, the study is conducted to develop a beach quality index (BQI) assessing the beach quality concerning the decision-making systems of the beach managers. The objectives of this chapter are (1) to develop a composite BQI in order to assess the environmental quality, human welfare and health concern; (2) the analyses of the main strengths and weakness of the selective beaches and identification of management priorities; and (3) providing some best suitable recommendations for the improvement of beach quality for promoting ecotourism infrastructure. Concerning those aspects, the study is conducted to identify the excellent quality of the beaches among the different coastal tourist's destination sites on the basis of indicators those support to maintain the beach quality. To provide more opportunities for the recreation and other activities of the tourists, it is essential to build up such kind of infrastructure which will promote the ecotourism development.

3.4 Methodology of BQI Estimation

The BQI is a single summarized form of composite index, comprises with eight indicators from the two main variables of (i) environmental quality (EQ) and (ii) human welfare and health (HWH) (Semeoshenkova et al., 2017). The indicators were selected in relation to their analytical consistency, measurability and importance to the beach quality

issues at the selective beaches. This analytical assessment is based on the literature review, existing beach quality systems and ratings by blue flag, Bathing Area Registration And Evaluation (BARE) system (Williams and Micallef, 2009). The composite BQI is estimated followed by Ariza et al., (2010) the each of the studied beaches concerning the opinion of the tourists about the questioning parameters (Plate 3.1) (Annexure 65). At first, the weight has been assigned against the individual parameters based on their impacts in deterioration of the beach quality after the questionnaire survey among the tourists. The respondents have given a suitable score varied from 1 – 4. The assigned scores have been aggregated against each site. Finally, the aggregated score has been categorized as poor (1), sufficient (2), good (3) and excellent (4) for describing the qualitative status of the beach. The composite BQI is estimated based on the following equations (Eq. 3.1, 3.2 and 3.3).

$$BQI = EQ + HWH \quad \text{.....(Eq. 3.1)}$$

$$EQ = ESW + CL + SH + TC \quad \text{.....(Eq. 3.2)}$$

$$HWH = SFT + CS + SF + HH \quad \text{.....(Eq. 3.3)}$$

Plate 3.1 Questionnaire survey during the field work in Mandirtala and Frejerganj.

3.5. Components of Beach Quality Index

3.5.1 Environmental Quality (EQ)

3.5.1.1 Ecological Status of Water (ESW)

The ESW includes the biological and physiochemical quality of the coastal water. The biological quality is estimated through the presence of elements like phytoplankton and macro benthos, whereas, the physiochemical quality includes the tropic index and specific pollutants like iron, salt and other element (Table 3.1) within the water. In the perspective of BQI, a satisfactory result of ESW indices should need to promote the ecotourism, and the unsatisfied result should recommend for the continuous monitoring of the water quality.

Table 3.1: Assessment of (ESW) indicator for the study beaches.

Indicators	Weighted Value	Coastal Destination Sites										
		A	B	C	D	E	F	G	H	I	J	K
Presence of phytoplankton and macro benthos in coastal waters (Yes/No).	0.5	0.3	0.4	0.25	0.10	0.30	0.10	0.10	0.25	0.1	0.05	0.25
The amount of phytoplankton and macro benthos present in coastal waters. (poor/moderate/good/ high).	0.5	0.3	0.4	0.3	0.5	0.25	0.05	0.05	0.20	0.1	0.05	0.50
What is the tropic index of coastal waters?	1.0	0.5	0.3	0.50	0.5	0.50	0.5	0.5	0.75	0.5	0.5	1.0
Water contaminated with specific pollutants (iron/salt/other elements/none).	1.0	0.5	0.5	0.3	0.4	0.50	0.4	0.4	0.25	0.6	0.5	0.50
Amount of specific pollutants present in coastal waters (poor/moderate/good/ high).	1.0	0.25	0.5	0.3	0.4	0.30	0.4	0.4	0.25	0.7	0.75	0.50
Final Value	4	0.37	0.42	0.33	1.9	0.37	0.29	0.29	0.34	0.4	0.37	0.37

3.5.1.2 Cleanliness (CL)

The indicators selected for the assessment of CL indices were based on the Environmental Agency and National Aquatic Litter Group (EA/NALG) under protocol 2000 for assessing the aesthetic quality of coastal as well as the bathing areas (Williams and Micallef, 2009).

Table 3.2: Assessment of (CL) indicator for the study beaches.

Indicators	Weighted Value	Coastal Destination Sites										
		A	B	C	D	E	F	G	H	I	J	K
Counting of litter over the standard Sampling unit (100 m wide transect (H.T.L. to L.T.L.) of the beach) area on the beach (low amount/moderate/high/very high).	1.5	0.5	0.75	1.25	1.5	0.5	1.5	1.5	1	1.0	0.75	0.40
Types of litters available on the beach (vegetation materials/garbage/plastics/glasses/others).	1.5	0.75	0.50	1.0	.75	0.5	1.5	.80	1.25	1.0	1.0	0.25
Time or season of the concentration of litters over the standard sampling unit area on the beach (pre-monsoon/monsoon/post-monsoon).	1.0	0.75	0.50	0.5	1.0	0.5	1.0	075	0.75	.80	.75	0.50
Final Value	4	0.66	0.58	0.91	1.08	0.5	1.33	1.02	1	0.93	0.83	0.38

The assessment was based on the primary-data collected during the field work. The volume of litter available over the beach area is estimated by selecting the standard sampling sites of 100 m stretch along the litter line/HTL on the beach. During the sampling was done through counting the numbers/volume of litter, types of litter and time or season of the concentration of litter remains on the beach (Table 3.2). The sampling was carried out at each of the coastal destination sites.

3.5.1.3 State of Habitats (SH)

The SH assessment was done based on the presence of different types of coastal habitats (flora and fauna) like nesting ground for turtles, grazing and feeding ground for red crabs, tidal flat with bio-turbation and other organisms in the beach, beach-dune transition and dune sections (Table 3.3).

Table 3.3: Assessment of (SH) indicator for the study beaches.

Indicators	Weighted Value	Coastal Destination Sites										
		A	B	C	D	E	F	G	H	I	J	K
Types of coastal habitats present in the standard unit of sampling area on the beach nesting ground for turtles (olive ridely)/ grazing and feeding ground for red crabs/tidal flat with bio-turbation and other organisms / beach fringed dune floral and faunal habitats.	1.5	0.375	1.1	1.25	1.5	.5	.25	1.5	1.25	1.25	1.30	1.5
Conservation status of habitats in the coastal site. Representing excellent-A (4) / Representing good -B (3) /Average and reduced conservation-C (2) / Absence of habitats-D (1).	1.0	0.5	0.75	1.0	1.0	0.5	.125	0.25	0.50	.70	.80	0.75
Types of Beach favourable for habitat development. Spit fringe beach.(4) / river mouth barred beach(3) / low – lying gently sloping beach flat(2) beach berm crested beach ridge with steeply sloping beach face (1).	1.5	0.75	0.75	1.2	.75	.25	0.0	1.5	0.75	.75	.75	0.75
Final Value	4	0.54	0.86	1.15	1.08	0.42	0.12	1.08	0.83	0.9	0.95	1

3.5.1.4 Trend of Coast (TC)

The assessment of TC indicator was based on those aspects which contribute to the indexing. The selected parameters were the changing volume of sediment in submerged and emerged beach, changing sediment volume caused by beach nourishment, changes in volume of sediment caused by withdrawals of sand for nourishment of eroded beaches, presence and state of maintenance or construction of hard structure, qualitative evolutionary trend of the shoreline and spatial trend of coast fringed with sea beaches (Table 3.4).

Table 3.4: Assessment of (TC) indicator for the study beaches.

Indicators	Weighted value	Coastal Destination Sites										
		A	B	C	D	E	F	G	H	I	J	K
Changes in volume of sediment in submerged beach. <10m3/m (4)/ 10m3/m(3)/ 20m3/m(2)/ 30m3/m(1).	0.50	0.1	0.40	0.25	0.10	0.25	0.50	0.40	0.10	0.40	0.40	0.50
Changes in volume of sediment in emerged beach. <10m3/m (4)/ 10m3/m(3)/ 20m3/m(2)/ 30m3/m(1).	1.0	0.25	0.50	0.50	1.0	0.0	1.0	0.60	0.50	0.50	0.75	0.30
Changes in volume of sediment due to nourishment.	0.25	0.125	0.25	0.20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Changes in volume of sediment caused by withdrawals of sand for nourishment of eroded beaches.	0.25	0.125	0.20	0.20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Presence and state of maintenance or construction of hard structures.	0.50	0.25	0.40	0.40	0.0	.30	.125	0.0	0.0	0.25	0.20	0.25
Qualitative evolutionary trend of the shoreline. Stable beach (4)/ Accretionary beach (3)/ Moderate rate of erosion (2)/ High rate of beach fringe shoreline retreat (1).	0.25	0.062	0.20	0.20	0.25	.25	.25	.25	0.20	0.25	0.25	0.20
Spatial trend of coast fringed with sea-beach. Bay beach(sediment tight) (4)/ Jeta shaped beach.(3)/ Straight coast line fringed beach.(2)/ Head land beach(1)	1.25	0.625	1.0	1.00	.75	.25	.25	1.0	1.0	1.0	1.0	1.0
Final Value	4	0.21	0.42	0.39	0.3	0.15	0.30	0.32	0.26	0.34	0.37	0.32

3.5.2 Human Welfare and Health (HWH)

3.5.2.1 Safety (Sft)

The Sft indicator evaluates the safety of bathing environment including the beach slope and wave height of the beaches and accessibility of safety related precaution in entire beach area. The assessment was formulated based on a rating scheme requires for the bathing area registration and evaluation (BARE) system, which can evaluate the beach types of the study area (Williams and Micallef, 2009). In the coastal area, safety is an important aspect for attraction of the tourists. Safety regulates the human behavior and wellbeing of the tourists in the coastal destinations. This indicator analyses the safety related parameters like the variation of beach slope, significant wave height during the bathing time, presence of lifeguards facilities, existence of boating zonation buoys, availability of the safety equipment, accessibility of the emergency vehicle, presence of the warning notice and presence of the coastal police to monitor and management the system of the beach area (Table 3.5).

Table 3.5: Assessment of (Sft) indicator for the study beaches.

Indicators	Weighted Value	Coastal Destination Sites										
		A	B	C	D	E	F	G	H	I	J	K
Beach fringed Nearshore slope type <1:10/>1:10	0.50	0.5	0.5	0.5	.25	.10	.25	.25	.40	0.25	.40	0.40
Significant wave height during bathing season <0.5m/>0.5m	0.50	0.4	0.3	0.3	.40	0.0	.50	0.50	.50	0.40	.035	0.50
Presence of Lifeguard facilities Yes/No	0.25	0.125	0.0	0.0	0.0	0.0	0.0	0.0	.25	0.0	0.25	0.0
Number of Lifeguards present per 100m shoreline distance <4/>4	0.25	0.125	0.0	0.0	0.0	0.0	0.0	0.0	.15	0.0	0.15	0.0
Number of drowning event during bathing season or per year(Age) (Gender) (Profession) <5/>5	0.25	0.125	0.2	0.2	.25	0.0	.25	0.0	0.0	0.10	0.20	0.20
Presence of boating zonation Buoys Yes/No	0.25	0.0	0.0	0.0	.25	.10	.25	0.25	.20	0.10	0.20	0.0
Presence of the fixed safety equipment Yes/No	0.25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.0	0.0	0.0
Availability of first aid post on the beach fringed areas. Yes/No	0.25	0.125	0.06	0.0	.25	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Presence of	0.25	0.125	0.0	0.0	.125	0.0	0.0	0.0	0.10	0.20	0.25	0.10

Warning Notices along the accident prone areas of the beach. Yes/No												
Presence of the emergency vehicle access to the beach Yes/No	0.50	0.40	0.5	0.3	.25	0.0	0.0	0.0	0.25	0.25	0.50	0.20
Presence of the police Booth behind the beach fringed shoreline. Yes/No	0.25	0.25	0.06	0.06	.25	0.0	0.0	0.0	0.20	0.20	0.25	0.0
Presence of watch tower on the beach fringed areas of seashore. Yes/No	0.50	0.5	0.0	0.0	0.0	0.0	0.0	0.0	.25	0.0	0.0	0.25
Final Value	4	0.22	0.13	0.11	0.17	0.02	0.10	0.08	0.2	0.12	0.19	0.14

3.5.2.2 Coastal Scenery (CS)

The CS indicator evaluates a quality of coastal landscape of the destinations. The indicator analyze the views and vistas of the area, types of coastal landscapes, colour of the sea water in bathing area, transparency of the sea water, presence of trees or other vegetations along the beach fringed shore, presence of river mouths or valleys across the beach fringed shores, presence of vegetation debris on the beach face or on the strandline, types of buildup environment of the backshore, the skyline of beach fringed shore, types of access to the beach extension, presence of sea wall, rip-rap boulders, cross spurs and other structures along the beach fringed shores and types of the utilities of the beach space (Table 3.6) are the indicators of this indexing.

Table 3.6: Assessment of (CS) indicator for the study beaches.

Indicators	**Weighted Value**	**Coastal Destination Sites**										
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
Views and vistas obstructed or unobstructed obstructed/unobstructed.	0.25	0.125	0.25	0.25	.125	.20	.25	.25	.15	0.20	.15	.20
Types of coastal landscape features attractive/unattractive	0.25	0.125	0.20	0.25	.25	.10	0.0	.125	.10	0.10	0.25	.25
Colour of the sea water in bathing area aquablue/grey	0.50	0.20	0.25	0.25	.50	.25	.25	.15	.25	0.10	0.20	0.50
Transperency of the sea water transparent/sediment in Suspension	0.50	0.20	0.20	0.20	.25	0.0	.25	.125	.10	0.10	0.20	0.25
Presence of trees or other vegetations	0.25	0.12	0.20	0.2	.25	.15	.25	.25	.05	0.2	0.1	0.2

along the beach fringed shore. Yes/No		5		5						5	5	5
Presence of Natural or unmodified sand dunes along the beach fringed shore. Yes/No	0.25	0.06	0.25	0.25	.25	0.0	0.0	0.0	.15	0.20	0.25	.20
Presence of River mouths or valleys across the beach fringed shores. Yes/No	0.25	0.25	0.25	0.20	.25	.20	.25	.20	.25	0.0	0.10	0.25
Presence of vegetation debris on the beach face or on the strand line. Yes/No	0.25	0.25	0.125	0.25	.25	.20	.25	.25	0.0	0.25	0.20	0.25
Types of build environment of the backshore. Roads and buildings/beach stalls and eco-huts.	0.25	0.25	0.25	0.0	.25	.15	0.0	0.0	.15	0.20	0.20	0.0
The skyline of beach fringed shore planted vegetations/resort structures	0.25	0.125	0.20	0.25	.25	.10	0.0	.15	.20	0.20	0.25	0.25
Types of access to the beach extension of roads/open access	0.50	0.25	0.50	0.25	.25	0.0	0.0	0.0	.20	0.25	0.50	0.25
Presence of sea wall, rip-rap boulders, cross spurs and other structures along the beach fringed shores. Yes/No	0.25	0.125	0.25	0.25	0.0	.25	.125	0.0	0.0	0.10	0.10	0.0
Types of the utilities of the beach space. Beach stalls/fairground/parking fishing boats/sand Sculptures/open sitting Arrangements.	0.25	0.125	0.25	0.25	.25	0.0	0.0	0.0	.25	0.15	0.25	0.15
Final Value	4	0.16	0.24	0.20	0.24	0.12	0.12	0.11	0.14	0.16	0.21	0.21

3.5.2.3 Services and Facilities (SF)

The availability of SF in any tourist destination sites is the main requirement to attract the tourists. It provides the development of the destinations and create the potentiality of the place. Therefore, there is need to provide the service and facilities to the tourists and look after the problems that affect the coastal tourists. The indicators that contribute in the indexing are the presence of beach cleaning services, existence of the facilities for sea viewing sites for the coastal tourists, presence of the open space for recreation and leisures

activities, availability of beach shakes or stalls, accessibility of facilities for changing cloths and wash rooms, presence of toilets and illumination facilities, sewerage and garbage dumping in treated and untreated conditions, presence of water sports and surf-riding facilities, presence of adventure sports by wind gliding and paragliding water sketing, presence of safety measures, supply of marine foods and drinking waters, facilities for recreation boating, sailing and recreation fishing, facilities for animal riding on the beaches, participation in sand art competition and arrangement of beach festivals for recreation activities in the coastal area (Table 3.7) are the indicators of service and facilities.

Table 3.7: Assessment of (SF) indicator for the study beaches.

Indicators	Weighted Value	Coastal Destination Sites										
		A	B	C	D	E	F	G	H	I	J	K
Presence of beach cleaning services. Yes/No	0.25	0.0	0.0	0.0	.25	0.0	0.0	0.0	.10	0.0	0.10	0.0
Presence of the facilities for sea viewing sites for visitors. Yes/No	0.25	0.25	0.0	0.0	.25	0.0	0.0	.125	.20	0.15	0.25	0.25
Presence of the open space for recreation and leisures(sun bathing) Yes/No	0.25	0.06	0.25	0.25	.25	.25	0.0	.125	.25	0.20	0.25	0.25
Availability of beach shakes or beach stalls Yes/No	0.25	0.25	0.0	0.0	.25	0.0	0.0	0.0	.125	0.15	0.25	0.0
Availability of facilities for changing cloaths,and wash rooms .Yes/No	0.25	0.125	0.0	0.0	.25	0.0	0.0	0.0	.10	0.0	0.10	0.0
Presence of beach toilets and beach illumination facilities Yes/No	0.25	0.00	0.0	0.0	.25	0.0	0.0	0.0	.15	0.0	0.10	0.0
Sewarage and garbage dumping in treated and untreated conditions treated/untreate	0.25	0.25	0.25	0.125	.25	0.0	0.0	0.0	0.25	0.15	0.10	0.0
Presence of water sports and surf riding facilities. Yes/No	0.25	0.125	0.0	0.0	0.0	0.0	0.0	0.0	.10	0.0	0.25	0.0
Presence of adventure sports by wind gliding,	0.25	0.06	0.0	0.0	0.0	0.0	0.0	0.0	.10	0.0	0.25	0.0

paragliding water sketing, Yes/No												
Presence of safety measures Yes/No	0.25	0.25	0.0	0.0	0.0	0.0	0.0	0.0	0.25	0.0	0.25	0.0
Supply of marine foods and drinking waters (green coconut water) Yes/No	0.50	0.3	0.125	0.0	.25	.20	0.0	0.0	.30	0.30	0.50	0.0
Facilities for recreation boating, sailing and recreation fishing Yes/No	0.25	0.0	0.0	0.0	.25	0.0	0.0	0.0	.10	0.15	0.25	0.0
Facilities for animal riding on the beaches Yes/No	0.25	0.0	0.0	0.0	.125	0.0	0.0	0.0	.10	0.0	0.25	0.0
Participation in sand art competition Yes/No	0.25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.10	0.10	0.25	0.0
Arrangement of beach festivals for recreation Yes/No	0.25	0.0	0.125	0.125	.25	0.0	0.0	0.0	0.25	0.15	0.25	0.25
Final Value	4	0.11	0.05	0.03	0.17	0.03	0.0	0.02	0.16	0.09	0.23	0.05

3.5.2.4 Human Health (HH)

The HH indicator is an essential factor as the public health problems caused by environmental contamination and emerging infectious diseases are a growing concern in the coastal area. An assessment of the HH indicator includes the parameters of the status of fecal contamination of sea water during bathing season, presence of toxic cyanobacteria in the sea water, abnormal situations (storm landfalls, tsunami attack and coastal floods) and its impact on the bathing environment, presence of dangerous species in the sea water in the beach areas, presence of accidental risks due to contamination of air, water, drinking water, shellfish and sand blowing by high speed winds and presence of malarial infection (Table 3.8).

Table 3.8: Assessment of (HH) indicator for the study beaches.

Indicators	**Weighted Value**	**Coastal Destination Sites**										
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
Status of faecal contamination of sea water during bathing season Absence/presence	1.00	0.5	1.0	1.0	.50	.50	.50	.50	.25	0.50	.25	.20
Presence of toxic cyanobacteria in the	0.25	0.25	0.25	0.25	0.0	.15	0.0	0.0	.10	0.10	0.05	0.05

sea water during bathing season Absence/Presence												
Abnormal situations impacting on the bathing water quality (storm landfalls, tsunami attack, coastal floods etc.) Absence/Presence	1.00	0.25	0.25	0.75	.50	.60	.50	.50	.25	.50	.50	.75
Presence of Dangerous species in the sea water and sea beach areas (animals, jelly fish) Absence/Presence	0.50	0.5	0.5	0.25	0.0	.50	0.0	0.0	.25	0.0	0.25	0.50
Presence of accidental risks due to contamination of air, water, drinking water, shellfish, and sand thrown high speed winds. Absence/Presence	1.00	0.5	1.0	1.0	0.0	.50	0.0	0.0	.25	0.6	0.6	.75
Presence of Malarial infection. Absence/Presence	0.25	0.25	0.25	0.25	.10	.15	.10	.10	.10	0.10	0.10	0.10
Final Value	4	0.37	0.54	0.58	0.18	0.44	0.18	0.18	0.2	0.3	0.29	0.39

3.6. Assessment of the Individual Indicator of the Coastal Destinations

3.6.1 Ecological Status of Water (ESW) of the Coastal Destinations

The quality of the coastal water is an important aspect for the tourists which are degraded due to the presence of various harmful nutrients. The results of ESW in different coastal destinations show the lowest weighted indices at the areas of Boatkhali (0.29) and Beguakhali (0.29) in compared to other sites (Fig. 3.1; Table 3.1). The lowest value reveals that the ESW quality of these two destinations is very poor. Due to the massive erosion, presence of many harmful nutrients, plastic and other materials damage the water quality. Similarly, in the areas of Dakshinpurosuttampur (0.33), Dadanpatrabar (0.33), Gangasagar (0.34), Mandarmani (0.37), Mandirtala (0.37), Bakkhali (0.37) and Frejerganj (0.4) have the sufficient ESW quality, as the water quality is better condition. Whereas, in Henry's Island (0.55) has a good quality. The Rasulpur represents the excellent water quality among the study sites as the highest ESW (1.9) is observed at this site. Therefore, concerning the ESW indicator Rasulpur is highly potential to develop the ecotourism infrastructure for the leisure and recreational activities of the tourists in the coastal area.

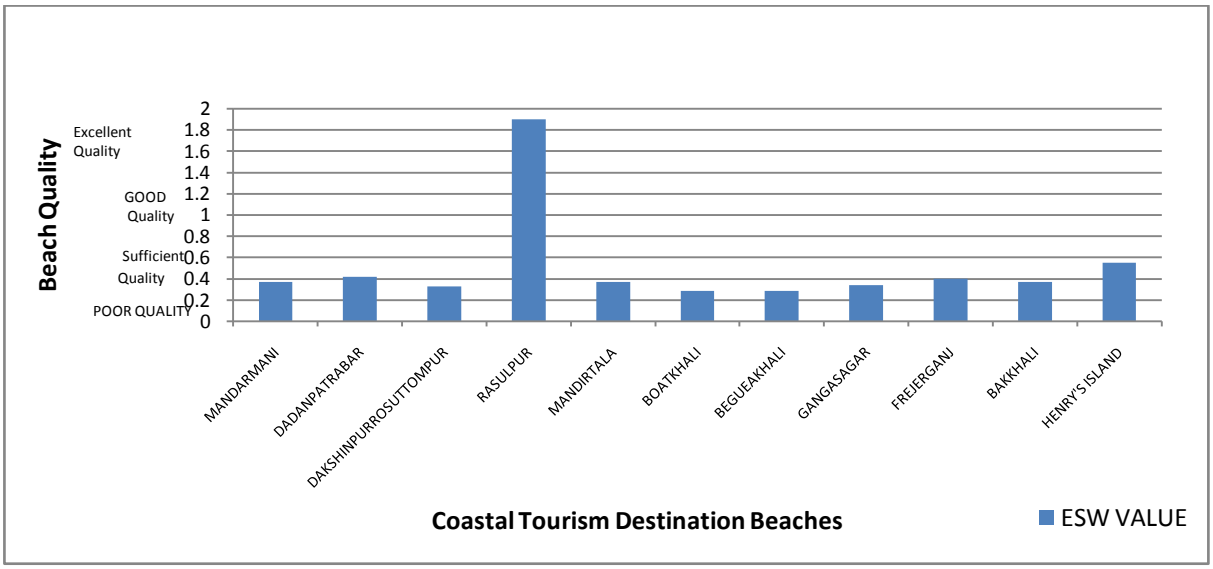

Fig. 3.1: Quality of ecological status of water of the study beaches.

3.6.2 Cleanliness (CL) of the Coastal Destinations

The natural beauty and the pristine beaches attract the tourists in the coastal destinations. But, the increasing tourists' pressures in the coastal areas are damaging its environment. Therefore, there have a need to protect the beaches from the damage and maintain the cleaning processes to develop the beach quality in the destination sites. The result of CL (Fig. 3.2; Table 3.2) reveals that in the excellent quality of clean beaches are observed at the destination sites of Boatkhali (1.33) and Rasulpur (1.08) because the presence of pristine and natural environment, absence of the beach litters and least damage by the tourists activities.

Plate 3.2: Coastal litter presents in Mandarmani beach.

However, the good quality beaches are resulted in the sites of Gangasagar (1.00), Beguakhali (1.02), Frejerganj (0.93) and Dakshinpurosuttampur (0.91). Here the quality of

the cleaning process in the beach is quite good. Moreover, the sufficient quality of cleanness is perceived at Bakkhali (0.83), Mandarmani (0.66), Dadanpatrabar (0.58), as Bakkhali and Mandarmani (Plate 3.2) are damaged due to the increasing pressure of the tourists and their activities during their holidays so the cleaning procedure is not maintain and this turn the place into sufficient quality of cleaning the beach destinations. While, Henry's Island (0.38) and Mandirtala (0.5) shows the bad quality as the coastal water as well as the coastal environment is constantly polluted due to the presence of plastics, bottles and sewages. So, there is need a proper management for the poor cleaning quality of the beaches.

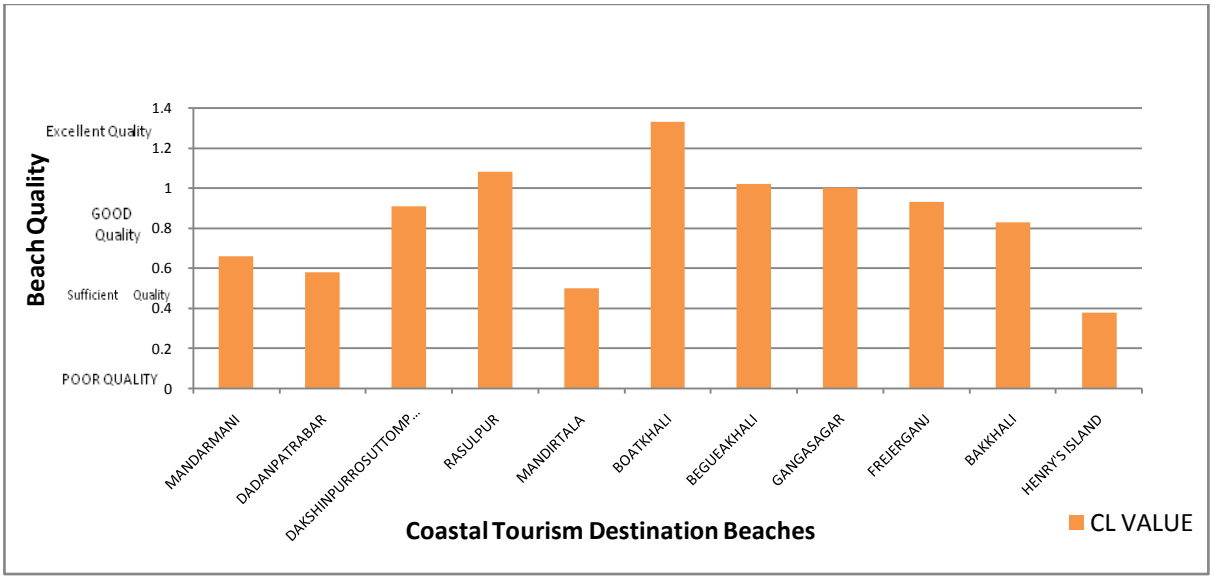

Fig. 3.2: Quality of cleanliness of the study beaches.

3.6.3 State of Habitat (SH) of the Coastal Destinations

The coastal area is enriched with precious flora and fauna. These species diversities glorified the beauty the tourist destinations which favored by the tourists. The entire study area is significantly accompanying with casuarinas, mangrove, red crabs and the olive turtle. The destination sites are under the sensitive and fragile ecosystems. Therefore, there have a need to protect the valuable coastal ecological resources for future tourists by analysis the overall status of the habitats. The environment and ecological status of the tourist destination sites are damaged from the unscientific activities by the immense tourists' pressure. So, it is necessary to analysis the indicators for developing and improving the beach quality in the study areas. The result reveals that (Fig. 3.3; Table 3.3) the excellent SH quality with the highest weighted value is observed at the sites of Dakshinpurosuttampur (1.15) and Rasulpur and Beguakhali (1.08) as the tourism pressure is less in amount remaining to others. The

good SH quality is perceived at Dadanpatrabar (0.86) and Gangasagar (0.83). The coastal environment of Dadanpatrabar (Plate 3.3) and Gangasagar are suitable for coastal habitats. The Bakkhali (0.95), Henry's Island (1.00) and Frejerganj (0.9) have the sufficient quality as the environment is not favourable for the coastal habitats. Whereas, Mandarmani (0.54), Boatkhali (0.12) and Mandirtala (0.42) have the poor quality to develop the coastal habitat as the degraded condition of the coastal environment of these destinations.

Plate 3.3 Coastal floral and faunal habitats in Dadanpatrabar.

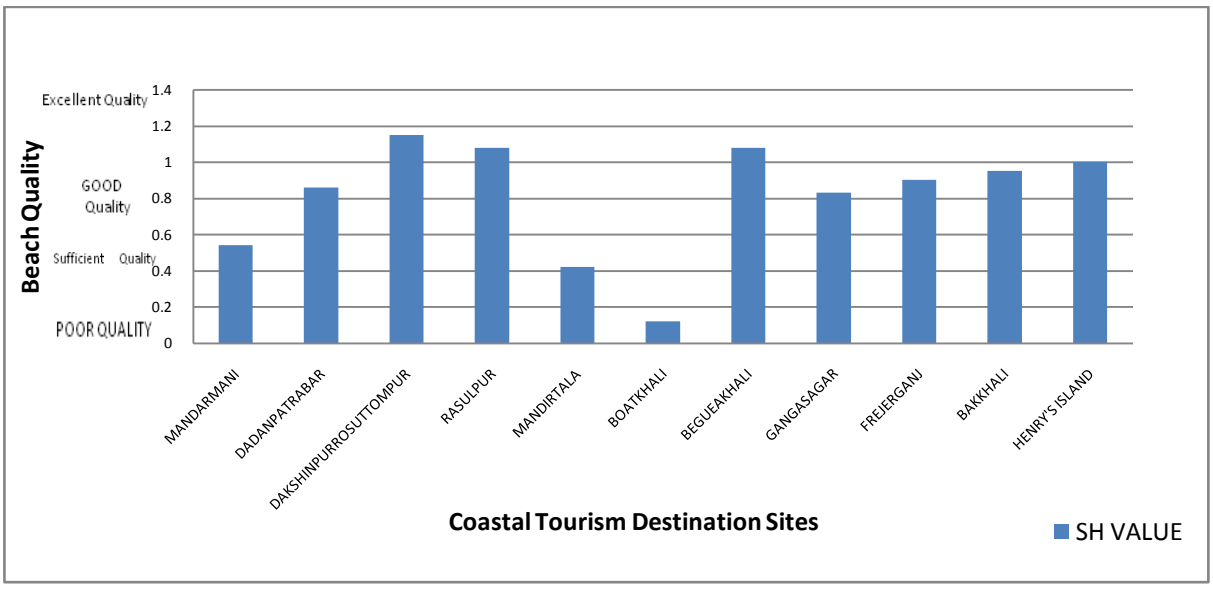

Fig. 3.3: Quality of state of habitats of the study Beaches.

3.6.4 Trend of Coast (TC) of the Coastal Destinations

After analysis the indicator it is found that (Fig. 3.4; Table 3.4) Dadanpatrabar (0.42) (Plate 3.4) Dakshinpurosuttampur (0.39) and Bakkhali (0.37) have the excellent TC quality as these beaches are not eroded and the condition of the beach is good. Henry's Island (0.32) and Frejerganj (0.34) have the good quality, as the flattened beach is favourable for the

tourist's activities. However, in Rasulpur (0.3) (Plate 3.4), Boatkhali (0.30) and Beguakhali (0.32) have the sufficient quality of the trend of coast as Boatkhali and Beguakhali are in erosive condition comparing to Rasulpur. However, Mandarmani (0.21), Gangasagar (0.26) and Mandirtala (0.15) have the poor quality as the amount of the erosion is high comparing to other beach.

Plate 3.4: Flattened beaches in Dadanpatrabar and Rasulpur.

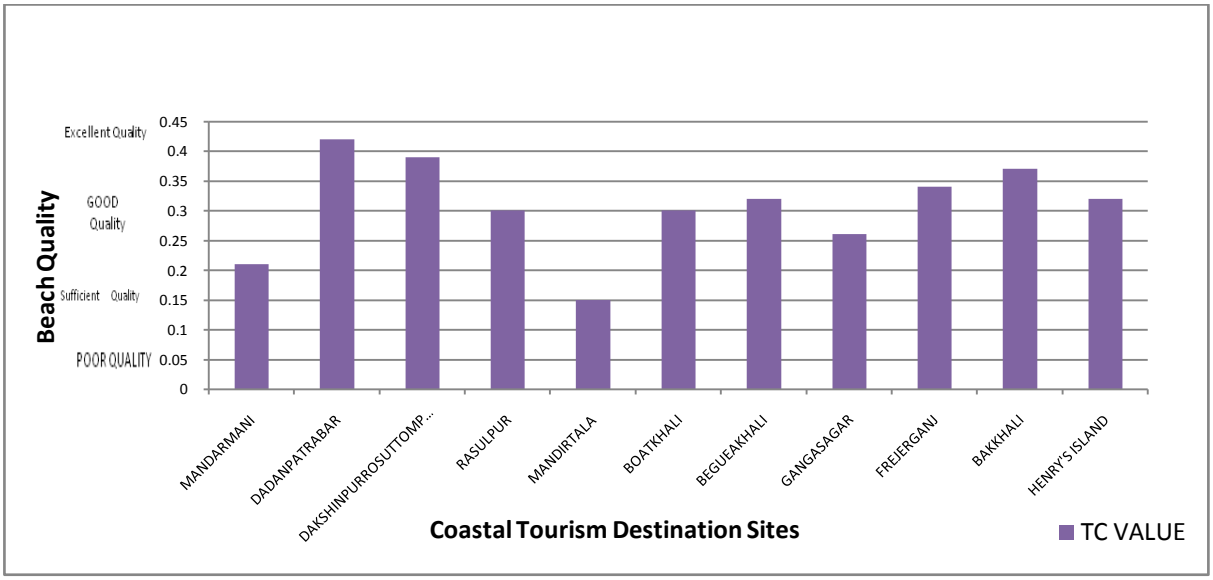

Fig. 3.4: Quality of trends of coast of the study beaches.

3.6.5 Safety (Sft) of the Coastal Destinations

Safety is the first requirement for tourists in the coastal area. Therefore, after analysis the indicator it is seen that (Fig. 3.5; Table 3.5) Mandarmani (0.22), Gangasagar (0.2) and Bakkhali (0.19) (Plate.3.5) have the excellent quality due to sufficient availability of safety equipment in the beach area. However, in Dakshinpurosuttampur (0.11), Rasulpur (0.17), Henry's Island (0.14) (Plate.3.5) and Frejerganj (0.12) have the good quality. As the presence

of bathing warning notice, present of coastal police, promote the good quality in Rasulpur, Henry's Island and Frejerganj. However, in Dadanpatrabar (0.13), Boatkhali (0.10) and Beguakhali (0.08) have the sufficient quality. Whereas, in remaining beach like Mandirtala (0.02) have poor quality due to the unavailability of any kind of safety equipment for the tourists.

Plate 3.5: Beach Safety information in Henry's Island and Beach safety equipments in Bakkhali.

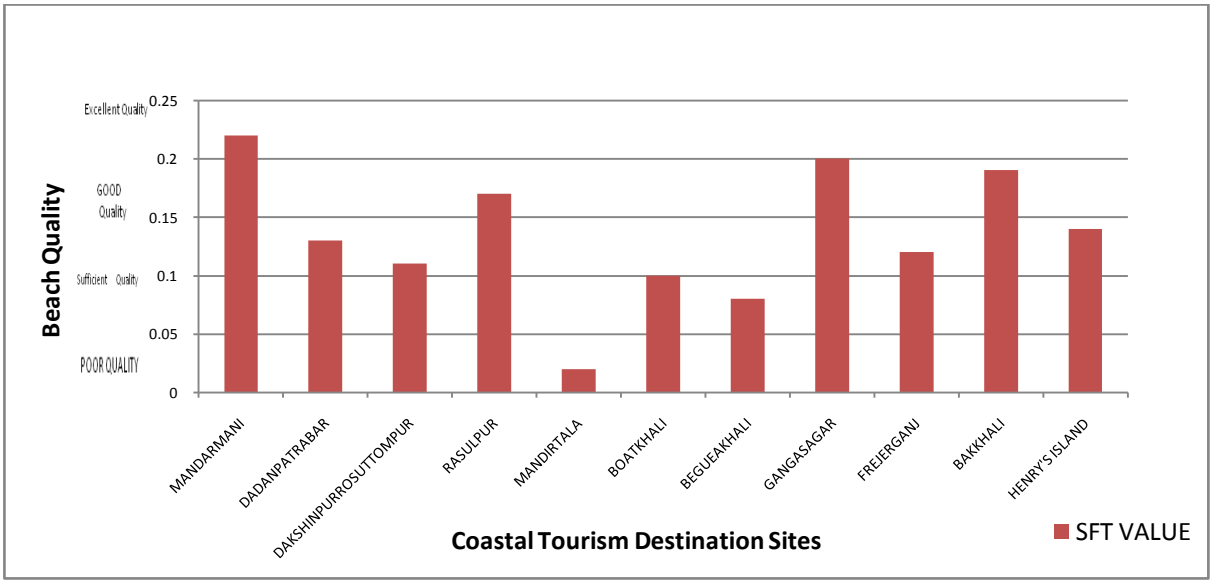

Fig. 3.5: Quality of safety of the study beaches.

3.6.6 Coastal Scenery (CS) of the Coastal Destinations

The coastal area is attracting by the tourists for its mesmerizing scenery, pristine beach and the beauty of the destination sites. Therefore, the CS indicator-based result shows that (Fig. 3.6; Table 3.6) the Dadanpatrabar (0.24) and Rasulpur (0.24) (Plate.3.6) are the example of the excellent quality for its natural environment and transparent water quality. Where, the site of Dakshinpurosuttampur (0.20), Bakkhali (0.2) and Henry's Island (0.2) are

developed at the weekend coastal stretch characterized by flat and quite stable beach represents the good quality. The sufficient CS quality is observed at the Mandarmani (0.16) and Frejerganj (0.1) as the, natural scenery are not so pleasant in these beaches. Whereas, in Mandirtala (0.1), Gangasagar (0.14), Boatkhali (0.12) and Beguakhali (0.11) experienced with low value that indicate the poor quality of the coastal scenery.

Plate 3.6: Coastal scenery in Dadanpatrabar and Rasulpur.

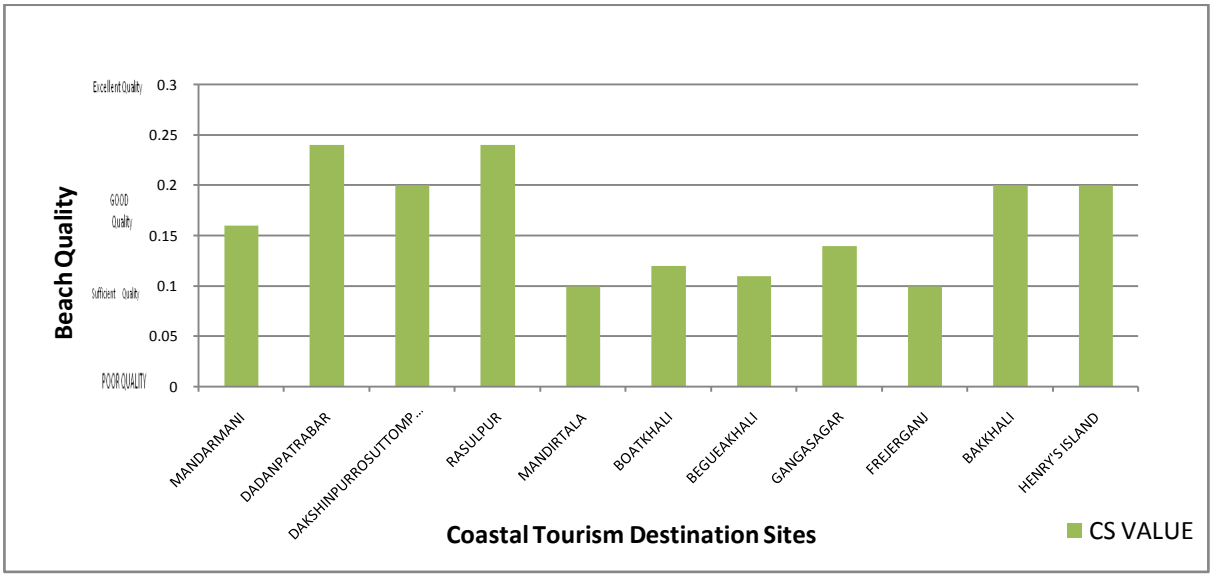

Fig. 3.6: Quality of coastal scenery of the study beaches.

3.6.7 Services and Facility (SF) of the Coastal Destinations

Services and facilities are an important factor for tourists. Therefore, after analysis the indicator it is seen that (Fig. 3.7; Table 3.7) the Bakkhali (0.25) represent excellent quality among the beaches. Similarly, the good quality assured by the available facility and services in Rasulpur (0.17) (Plate.3.7) and Gangasagar (0.16) beaches. Mandarmani (0.11), Henry's Island (0.05) and Frejerganj (0.09) get the sufficient quality of the indicator. The Boatkhali

(0.0), Beguakhali (0.02) and Mandirtala (0.03) are resulted with the poor quality for the absence of necessary services and facility for the coastal tourist's leisures and activities.

Plate 3.7: Beach recreation and beach stalls in Rasulpur.

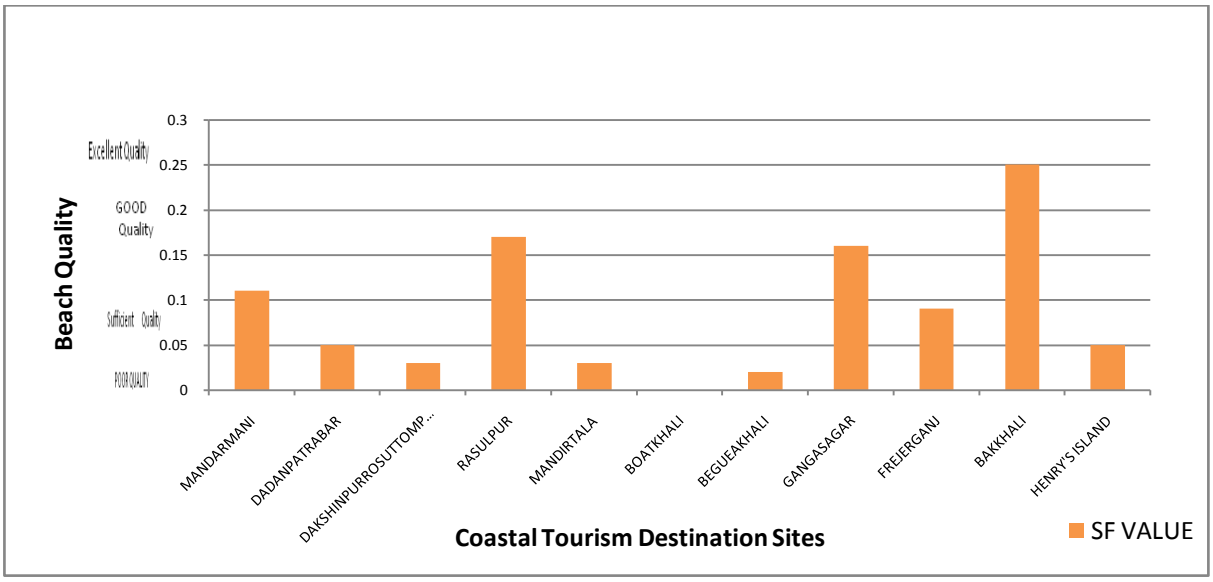

Fig. 3.7: Quality of service and facility of the study beaches.

3.6.8 Human Health (HH) of the Coastal Destinations

There is a need for the special attention of the tourists' health and wellbeing. In some coastal tourist destination sites, the human health is affected due to the pollution and degraded environment. Therefore, the tendency of illness and diseases like diarrhea, typhoid and other diseases can arise among the tourists from the polluted coastal waters due to fecal contamination. So, the tourism managers have to take it as the first priority to give an attention concerning health of the tourists in the destination sites. As per the result (Fig. 3.8; Table 3.8) it is observed that Dakshinpurosuttampur (0.58) and Dadanpatrabar (0.54) get the highest weighted value and represent the excellent quality. However, in Mandirtala (0.44),

Henry's Island (0.39) and Mandarmani (0.37) are experienced with the good quality. Although, in Bakkhali (0.29), Frejerganj (0.3) represent the sufficient quality of human health. Rasulpur (0.18), Gangasagar (0.2), Boatkhali (0.18) and Beguakhali (0.18) represent the poor quality of human health in the study area. However, any dangerous species or the abnormal situations are not found in the coastal area.

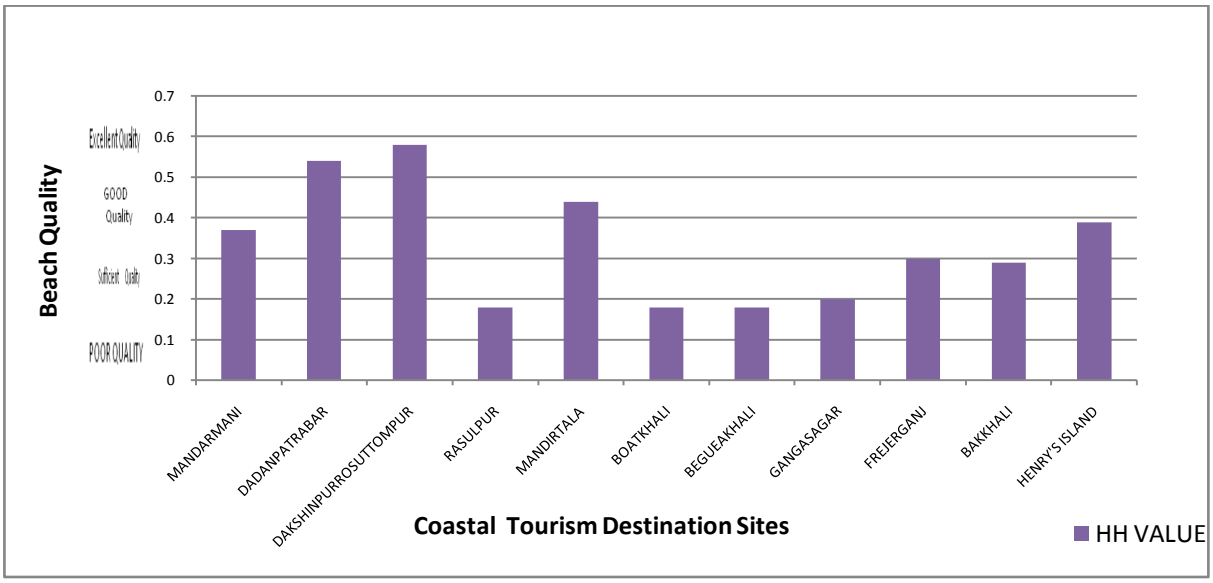

Fig. 3.8: Quality of human and health of the study beaches.

3.7 Status and Prospects of BQI Quality of the Coastal Destinations

The overall BQI is estimated based on the (Eq. 3.1) after considering the two components of EQ (based on Eq. 3.2) and HWH (based on Eq. 3.3) for the each tourist destination sites. The weight-based results of the components and individual indicators are shown in (Table 3.9) and the indices are represented with the help of geospatial techniques as a spatial mapping (Fig. 3.9). The overall BQI index ranges from 2.05 to 3.71 (Table 3.9) which shows the beach quality categories from poor to excellent among the all destination sites. Therefore, the overall BQI (Fig. 3.9; Table 3.9) reveals that the excellent beach quality is observed at Rasulpur and Dakshinpurosuttampur. Most of the sites (Dadanpatrabar, Beguakhali, Frejerganj, Bakkhali, Gangasagar and Henry's Island) are experienced with the good quality. The sites of Mandarmani resulted as the sufficient quality, whereas, Mandirtala and Boatkhali reveals the poor beach quality. Most of the coastal destination sites are degraded due to tourism pressure and rapid urbanization. Therefore, there is a need for the implementation of sustainable management strategies to restore the natural landscape of the different sites. The objectives of the management strategies should be taken concerning the improvement of human welfare and health, safety, comfort achieved by good services and

facilities, cleanliness and facilities. So, the primary goal for the destinations is to maintain a good state of the ecosystem and enhance the environmental quality as people choose these sites for their beautiful scenery, nature and pristine environment. Thus, the HWH component has higher importance than the EQ of the study beaches.

Table 3.9: Final BQI (Beach Quality Index) value of the study beaches.

Study Beaches	EQ	HWH	BQI	BQI Category
Mandirtala	1.44	0.61	2.05	Poor Quality (2.0 – 2.5)
Boatkhali	2.04	0.4	2.44	
Mandarmani	1.8	0.66	2.66	Sufficient Quality (2.5 – 3.0)
Henry's Island	2.25	0.79	3.04	Good Quality (3.0 – 3.5)
Beguakhali	2.71	0.39	3.1	
Gangasagar	2.43	0.7	3.13	
Frejerganj	2.57	0.67	3.24	
Dadanpatrabar	2.29	0.96	3.25	
Bakkhali	2.52	0.92	3.44	
Rasulpur	2.84	0.76	3.6	Excellent Quality (>3.5)
Dakshinpurosuttampur	2.79	0.92	3.71	

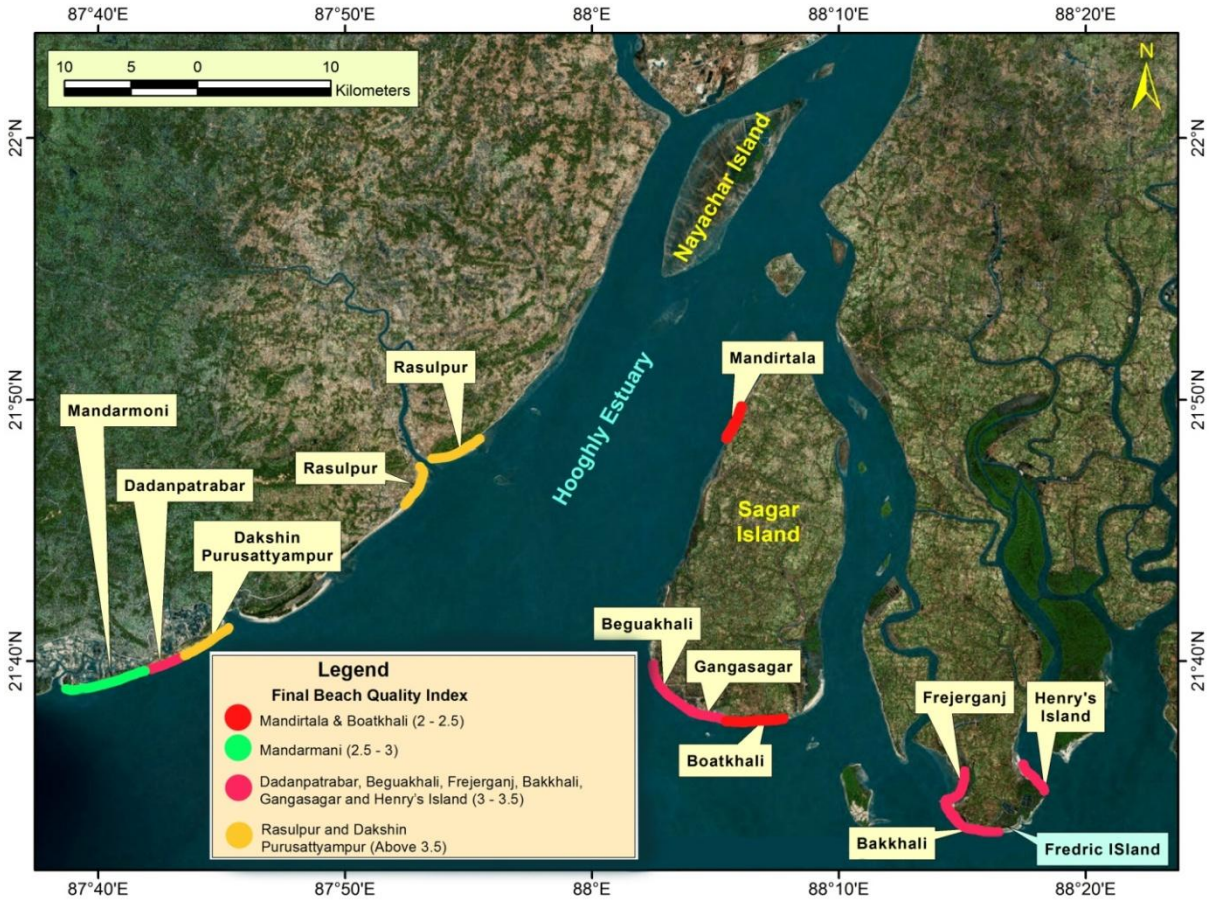

Fig. 3.9: Beach Quality Index (BQI) map of the coastal destination beaches.

3.8 Recommendations for Beach Management Strategies in the Coastal Destinations

The assessment of the individual indicators is allowed to identify the main weaknesses and strengths of the study beaches. The higher-rated indicators represent the main strengths, whereas, the lower-rated indicators represent the main weaknesses of the distinct destination sites. The lower-rated sites have needed a potential management proposal for their improvement.

Table 3.10: Possible management proposals for improving beach quality in the study beaches.

Recommendation For Beach Management	Study Beaches
Water Quality Monitoring: The quality of bathing water should be monitoring regularly to avoid any accidental risks and this will improve the ecological status of water.	ALL BEACHES
Awareness Raising: Aware the people about the beach quality and the necessity of beach conservation. That can be improve by doing environmental camping, warning notices, implement the rules and regulations about using the beach recreation for their safety.	ALL BEACHES
State of the Coast: Regular monitoring should be done to stabilize the coast.	ALL BEACHES
Coastal Protection Measures: Beach erosion can be prevented by maintenance of coastal protection structures and also by beach nourishment and beach fencing.	Rasulpur, Mandirtala, Dadanpatrabar And Dakshinpurosuttampur
Coastal Habitats: Coastal habitats are important resources of the environment. So, there is a need to protect the coastal habitats and develop the ecological value of the beaches and suggest management solutions for further improvement.	Mandarmani, Bakkhali
Cleanliness: The coastal region is sensitive. Therefore, to protect the coastal environment there should need a regular cleaning process to improve the ecosystem of the area.	ALL THE BEACHES
Beach Safety: The security of tourists is the priority of coastal destinations. So, provided the safety equipment is very much important to ensure the well being of the tourists.	Rasulpur, Mandirtala, Dadanpatrabar Dakshinpurosuttampur
Scenic Value: Coastal tourists always prefer the scenic beauty and pristine sea beaches of the place. Therefore, there should need to improve the beautification of the beaches like planting, seating arrangement of the tourists on the seaside and improve the beach nourishment to strengthen the coastal structures.	Mandarmani, Bakkhali
Services and Facilities: There should improve the services and facilities to the tourists like, regularly clean the beaches, litter bin should clean regularly, make safe the security of the tourists.	Rasulpur, Mandirtala, Dadanpatrabar and Dakshinpurosuttampur

The ESW is the main weakness and it should be improved. The Human and Health indicator is identified as one of the important factors for the assessment. So, the microbiological quality of bathing water and the presence of any potential risks of tourist health are a priority for regular monitoring in the coastal area. As the tourist destination sites

of the study area are included in the Coastal Regulation Zone (CRZ) of West Bengal and also part of the coastal zone management plan (CZMP). However, all the tourist destinations are present in the CRZ-1 regulation, so the management through the CRZ regulations by maintaining the norms and regulations under the CRZ notification. Therefore, through the depth analysis by applying the composite Beach Quality Index in the study beaches it identifies the EQ and HWH quality of the study beaches and recommended some beach management proposals (Table 3.10) for the future development of the coastal region.

3.9 Major Findings

The following are the major findings of this chapter

- Beach and Sun tourism is a prominent contributor to the coastal economy. However, it develops the beach tourism, boost up income and support the sustainable development of the coastal areas in long term process.
- BQI can appreciably contribute to the development of beach management framework and aimed to support an efficient management of individual beaches in the study area. As, beach management requires a holistic scientific assessment approach towards the protection of coastal environment ecosystem and quality improvement of the recreational areas.
- Rasulpur and Dakshinpurosuttampur represent the excellent quality for beach quality in the study area. Therefore, this destination sites are appropriate for the development of ecotourism infrastructure and maintain the sustainability.
- Mandirtala and Boatkhali have poor beach quality among the study beaches in the coastal destinations sites. As the water quality, erosion and absence of safety equipments are not present.
- The results of weighted averages, representing a higher importance of human welfare and health component for all the beaches because it direct affect the human well being in the coastal area.
- Therefore, there is a need of proper planning and improving the recommendation and individually management of the each indicators of the beach quality.
- There is need to establish a new sustainable strategies for beach management, in order to balance the socio-economical demands and preservation of the ecological and environmental status of beach systems or the quality of the study beaches.

- Several strengths are present here as, recreation activity, service and facility, natural beauty of the places. The weaknesses are the quality of the water, present of coastal litter, coastal erosion, proper services and facilities, presence of coastal police, degradation of the mangrove and decreased level of the coastal habitat are identified through this application that can be improvised through the implication of the indexing in the coastal destinations of the study beaches.
- Therefore, concerning the above condition of the coastal beaches there is need to practice the Ecotourism concept as it is the best way to maintain the sustainability and protect from the all damages that affect the tourist destination sites.
- So, regular monitoring and further assessment of beach related issues in this region is necessary for the timely identification of the problems and carrying out of the present and proper management decisions to maintain, restore or improve the beach quality in a sustainable manner in the coastal region.