INTRODUCTORY

1.0.0 INTRODUCTION

Construction of embankments on rivers is an example of human intervention to natural process of rivers. In the deltaic plain of West Bengal, embankments on tidal rivers were made to protect agricultural fields and settled areas from tidal surges. It can be seen as transformation of natural ecosystem into cultural ecosystem. The impediments are crucial for sustenance of human habitation of some parts of South 24 Parganas District of West Bengal, the area under review, and it is evident that breaching of those embankments is detrimental to that cultural ecosystem. The saline water that enters into the agricultural fields makes the soil unusable to yield crops for at least five years and directly damage the agro-ecological system.

The present research work is an attempt to examine the ecological impact of breaching of embankments made on the sides of rivers flowing in some areas of South 24 Parganas District on the local environment and people in general in one hand and on the communities bracketed in poor and marginal section of the social class on the other. Breaching of embankments is related mainly with the physical forces active in that particular area and some human interventions made to the embankments. The habitable parts of the study area as well as the agricultural fields are protected by these embankments, thus its breaching caused naturally or anthropologically invites detrimental effects to both the productive lands and settlements of all communities, but the impact are more effective on the people who live near or on the embankments. The communities in the area are segregated into variable economic and social classes, of which the marginal communities classified into SCs and STs suffer more afflictions from such breaching. These differential sufferings may not be minimized or compensated for by any uniform policy or management. Differential sufferings demand more micro level and group specific management strategies to be monitored by both the local and regional administrations along with the participation of the people from all groups. The embankments made on the natural systems normal for the unique estuarine ecosystem is actually an intervention to the nature of the ecosystem that bears its own rules, always tending to a balance in the gain and loss of matter and energy. The matter being the
sediment load and energy being the tides transformed into erosional forces. Thus this unique ecosystem always tends to be stabilized to balance the matter and energy through erosion and deposition. The breaching of embankment is an act of erosion, breaching being the result. The human communities need to introduce a management system to be adjusted with the balance to save their own space of production and settlement, equal space to be provided to the natural system, the rivers.

Embankments have been instrumental to vulnerable groups known as ecosystem people, not equipped to struggle against any change in their ecological sets. They become compelled to emigrate from the affected areas and are destined to change their livelihood patterns and ultimately become ecological refugees. Insecurity to food, shelter and life increase social inequality among the various groups of the people. The Aila of May 2009 caused to destroy nearly 778 km out of total 3500 km of embankments, by which the area under study suffered to a large extent. The Blocks like Sagar, Namkhana, Pathar Pratima, Kultali, Basanti and Gosaba of South 24 Parganas are mostly vulnerable to embankment breaching.

Production from land and water, for example, agriculture and fishing for survival and development of human groups of a particular area depend upon the availability, types and quality of the natural resources like land, soil, climate, vegetation and water bodies and the ecological systems interacting with those elements along with the adaptation of the human engineering processes suitable for productive activities. The area under review is a part of the famous immature or active depositional delta of the Ganges. Human presence in this part has been made possible by erecting embankments to keep saline water out of the agricultural fields. These earthen embankments are prone to erosion due to natural phenomena like violent storms, cyclones and tidal surges and due to some human activities like de-vegetization, shrimp farming and shrimp seed collection leading to breach of embankments with consequent widespread devastation of human subsistence and settlements in terms of loss of life and resources. The people of the area once transformed the immature forest-clad muddy ecosystem into mainly land-based cultural ecosystem. The transformed ecosystem became stable enough depending on the capacity to protect the cultural ecosystem from inundation with saline water. But some natural and human activities cause the breaching of the embankments retransforming the lands into unproductive saline lands unsuitable for agriculture. Thus embankment-breaching in the area in question imparts definite effects upon the life and economy of the concerned area.
The present study is an investigation to the question whether the embankments could be managed to sustain the livelihood of the islanders living in the eco-sensitive estuarine zone of West Bengal with a balanced state of natural and cultural systems.

1.1.0 THE STUDY AREA

The South 24 Parganas District has been considered as the area under study. The District is situated at the southern most fringes of the State of West Bengal and also within the Sundarbans delta, the largest pro-grading delta on the globe. It presents a complex model of ecological co-existence of diverse aspects in close inter-action with one another.

Table No. 1.1 Area under Study

<table>
<thead>
<tr>
<th>Name of the Sub-Divisions</th>
<th>Name of the Blocks</th>
<th>Name of the Island</th>
<th>Name of the Gram Panchayet</th>
<th>Name of the Mouza</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kakdwip</td>
<td>Sagar</td>
<td>Ghoramara</td>
<td>Ghoramara</td>
<td>Mousuni, Bagdanga, Kusumtola and Baliara</td>
</tr>
<tr>
<td></td>
<td>Namkhana</td>
<td>Mousuni</td>
<td>Mousuni</td>
<td>Krishnadaspur, Daspur, Uttar Surendraganj, Dakshin Surendraganj, Indrapur, Buraburir Tat, Sitarampur, Gobardhonpur and Sattadaspur</td>
</tr>
<tr>
<td></td>
<td>Pathar Pratima</td>
<td>G-Plot</td>
<td>G-Plot</td>
<td></td>
</tr>
<tr>
<td>Baruipur</td>
<td>Kultali</td>
<td>Maipith-Baikunthapur</td>
<td>Maipith, Binodpur, Baikunthapur, Kisorimohonpur and Bhubaneswari Char</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Gurguria-Bhubaneswari</td>
<td>Purba Gurguria, Madhya Gurguria, Debipur and Bhubaneswari</td>
</tr>
<tr>
<td>Canning</td>
<td>Basanti</td>
<td>Jharkhali</td>
<td>Jharkhali</td>
<td>Parbatipur, Laskarpur and Jharkhali</td>
</tr>
<tr>
<td></td>
<td>Gosaba</td>
<td>Satjelia</td>
<td>Satjelia, Dayapur and Sudhansupur</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lahiripur</td>
<td>Hamilton Abad, Luxbagan, sadhupur and Lahiripur</td>
</tr>
</tbody>
</table>

Source: District Census Handbook, 2011
It is predominantly a deltaic region formed mainly by the continuous deposition of silt carried down by the Ganga-Brahmaputra system. The administrative components of the District include 5 Sub-Divisions: (i) Alipore Sadar, (ii) Baruipur, (iii) Canning, (iv) Diamond Harbour and (v) Kakdwip. The District is composed of 33 Police Stations, 29 Community Development Blocks and 7 Municipalities. The study area extends from 21°29'00" North to 22°26'15" North Latitude and 88°03'45" East to 89°04'50" East Longitude. The major part of the District being covered by the Sundarbans region in the south and large Municipalities on the north and west, major emphasis have been given on six specific Blocks where the embankments are mainly concentrated and their breaching is most evident which comply with the objective of the present research. This can also be
considered as one of the rationales of selection of these six Blocks like Kultali (Baruipur Sub-Division); Namkhana, Pathar Pratima and Sagar (Kakdwip Sub-Division) and Gosaba and Basanti (Canning Sub-Division).

1.1.1 GEOGRAPHIC SPECIALTY

The area under review is an active delta and a land of marshes formed mainly by the continuous deposition of silt carried down by the Ganga-Brahmaputra system over the gentle continental shelf of the Bay of Bengal for thousands of years. The study area has several numbers of islands of the Sundarbans which are presently under cultivation but the water levels of the surrounding river remain periodically higher above the reclaimed lands. Innumerable channels and tidal creeks fed the area and the embankments made on the natural levees prevent the areas from flooding. During high tidal surge, flood inundation takes place and tidal channels are shifted by natural phenomena like deposition, erosion, river capture and by human interventions like early reclamation of the immature or juvenile floodplains of the interdependent interfluves and extension of settled culturable areas. Any estuarine ecosystem of the world experience similar phenomena. The following facts can be considered as geographic specialty of the area:

- An area with complex model of ecological coexistence of diverse aspects in close interaction with one another, being estuarine ecosystem classified as ‘nature subsidized solar powered natural ecosystem’ (Odum, 1975:43; Dash, 2001: 43-44).
- Except the Hooghly on the west, all other water channels are delinked from the headwater sources from the upland rivers.
- Free tidal flushing of the spill areas have been interrupted by premature reclamation of the land.
- Tidal rivers carry large volume of sediments only to be deposited on the riverbed, creating acute problem of drainage with a consequence to overspill the impediment and inundate the basins during tidal surge.
- The spatio-temporal changes in the tidal channels were occurred by natural phenomena like deposition, erosion, river capture and by human interventions like early reclamation of the immature or juvenile floodplains of the interdependent interfluves and extension of settled culturable areas.
- The rivers flowing over the area are obstructed by construction of embankments visible around the islands identified as administrative units.
- These phenomena, activities and results are seldom common to the areas situated outside the active parts; these are logically considered as geographic specialty.

1.1.2 RATIONALE FOR SELECTION OF THE STUDY AREA

Most of the area under study is tidally active, where erosion and accretion of land remain active the year round. The rivers deposit sediments estimated at over a billion tonnes annually at the sea mouth, a large part of which is then carried by high tides into numerous creeks and estuaries in the delta. With every gush of the high tides, the islands get eroded and mudflats are formed. Nearly 2.5 million people live on these islands that constantly change shape. Most mud embankments that guard the islands today were built during the Colonial rule, some 250 years ago with clearing of forests and settling people on the islands to earn revenue from agriculture. Embankments were built to prevent ingress of saline water. On the flip side, this impeded the process of silt deposition on the islands and riverbeds which became elevated and river water flows above the island levels. The rise in sea levels due to global warming poses another threat; according to a report by Delhi-based Centre for Science and Environment, sea level has been rose at an estimated height of 12 mm per year in the last decade (Ghosh, 2012: 91). Without embankments, human life is impossible in these islands. Simultaneously, rivers also eat up into the fragile islands. Retreating embankments are reconstructed to give more space to the rivers. The practice is well-established in the area under study.

The area thus delimited has been facing a great transformation both in physical and socio-economic characteristics. Establishment of the impediments and purposive clearance of forests with reclamation of immature deltaic land may be marked as prelude to the separation of nature and culture. Embankments are the walls against the way of natural process. But after such separation, embankments proved as the only protector or saviour to the once established mosaics and compartments of cultural ecosystems. These ecosystems are vulnerable to the surges of sea water brought in by tides, sometimes dreadfully enforced by speedy winds of storms and cyclones, causing breaching of embankments in various scale. The larger section of the people belong to the marginal community, bracketed in the category of Scheduled Castes in social classification, economically practicing subsistent economy with very less or no surplus income and thus
mostly grouped in marginal labourers living on the land literally marginal in location and marginal in productivity too. Thus the marginal people living on marginal land at marginal location are unique to be treated as rationale for selection. The very existence of these communities settled in such unique deltaic-estuarine environment is dependent on the stability and protective capacity of the embankments. Though the area suffers from workable transport network, but not inaccessible in the sense of collection of information.

1.2.0 OBJECTIVES

The objective of the proposed research work is to enter into the exercises regarding identification of the natural and anthropogenic factors and processes responsible for decay and breaching of the embankments once engineered to protect the life and resources in various parts of the district located on the active delta region significantly influenced with mangrove forests, to probe into the impacts of decay and breaching of those embankments on physical and human ecological aspects of the selected area and to formulate an eco-friendly management plan on the basis of observation and available data.

1.2.1 HYPOTHESIS

The life and economy of the selected Blocks of South 24 Paraganas District, vulnerable to breaching of river embankments, may be made sustainable with implementation of proper scientific management system combined with people’s participation.

Diagram No. 1.1 Hypothesis
1.2.2 RESEARCH QUESTIONS

The present work is based on the fundamental questions listed below:

- What ecological specificity does the area posit?
- What are the forces and factors instrumental to breaching of embankments in the area?
- What are the impacts of such breaching on the natural and cultural ecosystems?
- Can the economic and social problems caused by breaching be reduced with proper and scientific monitoring?

1.3.0 HISTORICAL BACKGROUND

The name of South 24 Parganas District came from a number of Paraganas comprised in the Land Lordship of Calcutta which was abandoned to East India Company in 1757 by Mir Jafar, the then Nawab (King) of Bengal. Nawab Mir Jafar, made an agreement with the East India Company on the 20th December 1757 regarding the Zamindari or landholders right over a tract of country known as the Zamindari of Calcutta or as the 24 Parganas Zamindari from the number of Parganas including in it (Gaz. 24 Pgs., 1994: 87). The names of such Parganas were: (1) Akbarpur (2) Amipur (3) Azimabad (4) Balia (5) Baridhati (6) Basandhair (7) Calcutta (8) Dokhin Sagar (9) Garh (10) Hathiagarh (11) Ikhtiarpur (12) Kharijuri (13) Khaspur (14) Maidanmal (or Mednimall) (15) Magura (16) Manpur (17) Mayda (18) Munragacha (19) Paikan (20) Pechakuli (21) Satal (22) Shahnagar (23) Shahpur, and (24) Uttar Pargana. The tract lay chiefly to the south of Calcutta and comprised of an area of 882 mile². 24 Parganas District has been bifurcated into two Districts such as North and South 24 Parganas Districts on 1st March 1986.

The great epic of Mahabharata and some of the Hindu holy book includes references of the Gangetic delta and importance of the landmass at the dawn of the history. At the time of Raghuvansa, the Pillars of Victory on the isles in the midst of the Ganges was established by Raghu, in all probability, these islands represented the present area of the Twenty Four Parganas. Gangaridae, Gangaridai, Gangarides were the main habitant in this landmass but till date very little is known about these people. References to this area is also found in the writings of Greek navigators, geographers, chroniclers and historians during first century B.C. and the third century A.D. accounts of Diodorus Siculus, Pliny, Ptolemy, Q. Curtius Rufus also has reference of the study area. Ptolemy’s map of the
second century A.D. shows the south of the delta as cut up by rivers and estuaries to such an extent that it was practically a collection of islands. In the seventh century, A.D., the district may have formed part of the land referred as ‘Samatata’ as described by the Chinese pilgrim Heuen Tsiang (Yuan Chwang). It was a low-lying country bordering of the sea and rich with crops, flowers and fruits.

During 1561 to 1611 A.D. Hindu Bhuiyan Pratapaditya, ruled the Sundarbans. He was one of the famous Baro-Bhuiyans (literally meaning Twelve Chieftains) of Bengal and established an independent Hindu rule in Bengal. He fought against the Mughal imperial army during 17th century and succeeded to the kingship in 1574. His territories covered the greater part of what is now included in the greater Jessore, Khulna, Barisal of present day Bangladesh and large portions of present day South 24 Parganas District.

It is known from the history of the District that during the Muslim rule in Bengal, the area covered was included in Satgram Kingdom in Bengal. The civic, criminal and revenue jurisdiction of the District underwent some changes during the period from 1757 to 1800 A.D. In order to overcome administrative inconvenience, the District was divided into parts in 1814 and 1834 A.D. respectively. The jurisdiction of the Sub-divisions was changed as and when required. But afterwards, for administrative exigency the District remained intact for a pretty long time.

During the Wahabi Movement in Bengal under the leadership of Titu Mir (Titu Miyan), a resident of undivided 24 Parganas, against the British Government, the District was highlighted. Another most notable event in the history of the District was the mutiny which broke out among the Sepoys (soldiers) at Barrackpur during the Burmese War (1824). Again in 1857, the Mutiny broke out in Barrackpur town of the 24 Parganas District. At that time Barrackpur was the Head Quarters of the Presidency Division of the Army, under the command of General John Hearsey. The Sepoys refused to use the cartridge greased with fat of cows or swine which the Sepoys had to bite before loading and this was the primary cause behind the Sepoy Mutini. It had a great impact not only in the army but also in the civic body. This District achieved its aristocracy through all these events.

In 19th Century, some police stations of Nadia and Jessore were amalgamated with the District. 8 Sub-divisions were formed during 1861 in the District such as (1) Alipur (2) Diamond Harbour (3) Barasat (4) Barrackpore (5) Dum Dum (6) Baruipur (7) Basirhat,
and (8) Satkhira. The physical features of the district are those common to deltaic land within the limits of the Gangetic delta and it is little raised above flood level. 24 Parganas District has been bifurcated into two districts namely North 24 Parganas and South 24 Parganas on 1st March 1986 (District Census Hand Book, 2011: 9-11).

1.4.0 RELEVANCE OF THE PRESENT STUDY

Embankment, for its importance as an artificial barrier designed to provide protection against flooding, is constructed and managed for all aspects of survival and development by all hydraulic societies throughout the world. The inherent character of the embankment is to protect flooding of low lying areas from seas, lakes or rivers adjacent to the land. But the same embankment obstructs the siltation of island that causes rise of river bed leading to flood hazard. Without embankment the very survival of deltaic people becomes questionable because embankment breaching or absence of embankment causes ecological, social and economic vulnerability of people.

The human communities living in and around water dominant estuarine and coastal ecosystems adjusted to active deltas and land of marshes of humid tropical climatic regime of the world, for example, the Sundarbans in West Bengal has a common experience of embankment breaching and livelihood vulnerability. People adapted with that specific ecosystem are generally called as ecosystem people unable to cope up with the increasing intensity of cyclonic storms, tidal surges and other climate change phenomena. Thus earthen embankments have been constructed to shelter the people from saline water intrusion of the tidal rivers and to revert back high tidal surges. Early mature reclamation of the Indian Sundarbans in the form of raised embankments has resulted in disequilibrium of fluvial dynamics and leads to decline of spill areas of the rivers. The sediments are deposited on the riverbed itself and the low mud flats remains devoid of sediments. Thus in the Sundarbans, the settlements are at a lower level than the rivers and are liable to persistent flooding. Frequent flooding makes people insecure of food, shelter and life. The agricultural, fishing activities are getting affected which is compelling people to change their livelihood pattern and to migrate into cities in search of work.

The IPCC report as well as other studies have warned about the impact of sea level rise due to climate change and its direct impact upon the coastal belts over the world (The Intergovernmental Panel on Climate Change, 2007: 331-332). The Blocks like Sagar, Namkhana, Pathar Pratima, Kultali, Basanti and Gosaba of South 24 Paraganas are
mostly vulnerable to climate change and embankment breaching. The present area, interspersed and crisscrossed with tidal rivers is experiencing effects of tidal surge at the cost of loss of land, property and life. Embankments on these tidal rivers protects from devolution of the islands and lands as principal resource base. The breaching of embankments is a process related to the natural phenomena: climo-hydraulic forces. Loss of resource has direct and indirect impact upon the people settled in the area that ultimately invite social tension and insecurity, emigration of male population strengthen such insecurity, in a number of places report of girl child trafficking from the Blocks under study cannot be denied. Thus the study is relevant to physical, economic, social as well as human ecological questions.

1.5.0 BROADER IMPLICATIONS

The narrowly defined objective cannot but have some broader implications and linkages between breaching and its ecological and socio economic impact. Each and every study has certain beliefs, values and assumptions in its background and thus depends upon certain methods of enquiry and analysis and also upon the quality and quantity of information available. One of the major implications of this work is that it is a direct result of a conviction in ecological principles. To any researcher who plans for some research about the breaching of impediments and its ecological significance, the impact upon environment and society is established almost instantly.

The premises upon which the study is based are that breaching of embankment has a wider impact on people living in the coastal areas throughout the world. Embankment breaching not only affects the ecology and environment of the area concerned, it causes socio economic vulnerability of people for which larger number of rural folks are migrating from the area under review to the industrial centres for survival. The premises of the study depend upon direct proofs of impacts of such deteriorations identifiable over time and space; but such proofs cannot be meaningfully presented unless the study is made both space and time specific. The Community Development (CD) Blocks of South 24 Paraganas have been selected to restrict the territories, but not without apriority reasons. On the basis of subjective information, these CD Blocks of the District stand out significantly above others not only in terms of embankment breaching and socio economic and ecological vulnerability but also in terms of unique mangrove ecosystem and presence of river based social systems.
1.6.0 THE DATA BASE

A research work with time-bound and space-bound relationship is naturally expected to depend on some definite data. A study on perspectives of the impact of embankment breaching should not depend only on some quantitative and statistical information, but also some qualitative information to be derived from facts, reports, records, even from oral interviews. The data and information that are used in the present research work have been collected from different sources, which are secondary and primary in nature as well as some of the information are published while some are unpublished.

Secondary information have been collected mainly from different Govt. and Non-Govt. published records, reports, drafts, gazetteers, maps, images, books and journals relevant to the present work. The database also includes Census statistics. The primary data collection is considered as the important basis for the whole research work. The primary data has been collected through detailed field survey on households in the selected parts of the study area. Data also have been collected in the form of oral interviews of the officials and individuals of the mouzas and responses gathered from selected communities are primary in nature.

1.6.1.0 SECONDARY DATA

Secondary data and information are needed for the present research work basically to investigate the conditions of education, health, infrastructural and also social field. Secondary data and information are mainly collected from different Govt. and non-Govt. published records, reports, drafts, gazetteers, maps, books and journals which are closely related to the present work.

1.6.1.1 REPORTS, RECORDS AND MEMOIRS

Old data and information on land, change of river courses, change in land use, reclamation of premature delta, construction of embankments, breaching of the embankments and its socio-economic and ecological impact have been gathered from a number of records and reports. A few numbers of the more important old records and reports conferred with may be pointed out here as

i. Report of the Census of Bengal by H. Beverly (1872)
ii. A Statistical Account of Bengal (Vol. 1 24 Parganas and Sundarbans) by W. W. Hunter (1875)

iii. The Tribes and Caste of Bengal: Ethnographic Glossary (vol-1 and 2) by H. H. Risley (1891, 1893)

iv. Committee Report on Hooghly River and its Head-waters by Stevenson Moore (1919)

v. A Revenue History of Sundarbans from 1870 to 1920 by F. E. Pergiter (1920)

vi. The Bengal Embankment Manual by Henry Leland Harison (1875)

vii. Historical Introduction to the Bengal Portion of the “Fifth Report” (Vol 1 and 2) by W.K. Firminger (1812) on Bengal

viii. Early Revenue History of Bengal and the Fifth Report, 1812 by F.D. Ascoli (1812)

1.6.1.2 GAZETTEERS

The West Bengal District Gazetteer, 24 Parganas, (Govt. of West Bengal) in different time has become helpful in collecting the information on the physical, economic and social aspects of the concerned area. The topographic characteristics, large and small rivers, climatic condition, flora, fauna, population composition, transport and communication networks are described in Gazetteer which helped to collect information for the present work. The most important Gazetteers which have been considered are:

i. Bengal District Gazetteer by Govt. of Bengal (1871, 1926,1937)

ii. Imperial Gazetteers of India, Provincial Series by Govt. of India (1901)

iii. L.S.S. O’Mally, Bengal District Gazetteers: 24 Parganas, Calcutta, 1914

iv. West Bengal District Gazetteers : 24 Parganas District by Govt. of West Bengal (1994)

1.6.1.3 CENSUS HANDBOOKS

The data and information on various aspects of population, economic and social structure have been compiled from the following sources:

1.6.1.4 LETTERS, PROCEEDINGS AND REVIEW

Information on physical, social, cultural as well as the economy of the Sundarbans has been gathered from different proceedings, letters and reviews.

i. Calcutta Gazette, 1788
ii. Proceedings of Revenue Department, Government of Bengal (1869)
iii. Sundarbans Mangal, 1999

1.6.1.5 MAPS AND IMAGES

A number of maps have been consulted to fulfil the objectives of the present research work:

i. Survey of India (15’x15’) Topographical sheet (Scale1:50,000): Number 79B/12, 79B/16, 79C/1, 79C/2, 79C/5, 79C/6, 79C/9, 79C/10, 79C/13, 79C/14 (1972-97) (Map No. 1.2)
ii. Army Map Service, USA (1:250000): NF 45/7,8,11,12 (1922-1943)
iii. Renel’s Map (1781), Map of Bengal Presidency (1917)
iv. Maps from Census Handbooks, District Maps, Police Station Maps and Cadastral Maps.
v. Maps from NBSS and LUP, NATMO, GSI
vi. NRDMS Office, Kolkata
vii. Google Images : 1984 to 2017
viii. Landsat TM, ETM+ Data of different Dates

1.6.1.6 UNPUBLISHED BLOCK-LEVEL INFORMATION

Data on embankment breaching and repair, irrigation etc have been collected from Block Development Office; information on health and diseases has been gathered from the Office of the Chief Medical Office; data on MGNREGA is obtained from Panchyat and other Offices.

Important other departments are:

i. Sunderbans Development Authority, Irrigating Department
ii. Block Disaster Management, South 24 Paraganas
1.6.2.0 PRIMARY DATA

The data on various purposes relevant to the objectives of the research work have been generated from the intensive and rigorous field study at different mouzas. Primary data have been collected from field visits, with structured questionnaire schedule and by oral interviews.

1.6.2.1 DATA GENERATED FROM FIELD VISITS

Quantitative information collected from field visits through oral interviews and structured questionnaire schedule have helped attempt at quantification in some cases. The data includes present education, health, economic and social status of the rural people of the selected mouzas. Some important data concerning the impact of embankment breaching have been collected and checked through field visits which have helped much in analyzing qualitative aspects. Data have been cautiously gathered about the availability of health care facilities, problems of agriculture, loss in settlement area, and loss in agricultural area etc. from the field survey.

1.6.2.2 STRUCTURED QUESTIONNAIRE SCHEDULE

A structured questionnaire schedule has been prepared for the present study, with purpose to collect primary data from the field. All the questions in the questionnaire have been divided in five separate groups to fulfil the objective of the research work such as questions relevant to the field of education, health, economic, social and infrastructural indices.

1.6.2.3 ORAL INTERVIEWS

Some direct and micro-level information have been gathered through oral interviews with some selected target groups.

1.6.3 LIMITATION OF THE DATA BASE

However, the data used in this research work suffer from some limitations. Most notable limitation in this regard is that the local administrative bodies lack adequate classified information pertaining to different aspects of the area under review. The main limitations of the data base are:
• Data on exact depth of breaching suffers from inaccuracy

• Various public and private official records on times, length and location of breaching are sometimes inconsistent

• Direct interaction with the officers and stuff members have resulted some obvious facts, but they did not responded to all queries, probably due to their official trade secrets.

• The data collected from oral evidences has also some shortcomings.

• So, at the time of interview, the impact of breaching on economic and social aspects may not be felt by every respondent in the same manner. Those who could find substitute sources of income and public help have bothered little in this regard.

• The heterogeneity of population composition may also cause a remarkable difference in the estimation of economic hardships and differential sufferings.

• Above all, the remote points of breaching and villages are obvious limitation to the data base.

1.7.0 REVIEW OF LITERATURE

The thesis itself justifies the relationships between embankment breaching of the area under review and its ecological, social and economic vulnerabilities faced by the people associated with the natural ecosystem. The literatures, reports and records available in this context may be explained in a time frame from 1868 to till date. But we must be clear that the data and information so far available for that period suffers from discontinuity, may be treated as ‘recorded selected incidents’, many of the literatures published before 1868 had hardly direct concern with the ecological significance of breaching and vulnerability of people but a number of reports, records, books, journals and research papers draw deep attention of the general people and administrators regarding the causes and consequences of perceptible degree of deterioration of the rivers and the wetlands.
W.W. Hunter, (1868), *Annals of Rural Bengal*

The book explains the physical aspect of the District including boundaries, jurisdictions, status of river systems and other water bodies, reclamation of marshes in one hand and attempts to make an image of people responding to that physical environment on the other hand. It also points out the agricultural patterns and prospects, land tenure systems, domestication of animals, irrigation practices, and socio-economic condition of people, transport, communication system, response and responsibilities of the people to the natural calamities as well as the meteorological and medical aspects of South 24 Parganas. The whole work of Hunter is done under the supervision of the British rule, the documents of Hunter are very much analytical and research oriented. The information put in the series has been of immense help for this work but the very objective of the present work is different. The book has helped this work in some aspects but with clear differences in the notion and objectives of the research work.

L.S.S. O’Malley, (1914) and reprint (1998), *Bengal District Gazetteers, 24 Parganas*

The gazetteer informs about the physical aspect, history of the people, agricultural system, drainage system, and history of embankment, natural calamities, economic infrastructure, transport and communication system, land revenue system, general administration, information regarding local self governance of South 24 Parganas. The Gazetteer mainly helps in this research to get information regarding the construction and maintenance of embankment by Public Works Department. Vivid description of the location and length of embankments are available from this book.

F.E.Pergiter, (1920), *A Revenue History of Sundarbans, Vol-II (1870 to 1920)*

The history vividly expresses the revenue system of the Sundarbans from 1870 to 1920 including a mine of information regarding the land revenue system and agricultural system of the Sundarbans. The history of formation of the islands, settlement pattern, physical and hydrographical problems of the Subdarbans is discussed lucidly. The book also discusses the past extension of the act regarding embankment in the Sundarbans. The book has helped much regarding the description of Fraserganj and Sagar Island.
D. K. Sinha, (1994), *Natural Disaster Management: The West Bengal Scenario*

The edited book by the Indian Science Congress Association depicts cyclone, flood, landslide hazard, meteorological network evolution and many other natural disasters of West Bengal. The management policies and the relief and welfare service for vulnerable group are also given proper stress in the writing. The book has been proved helpful for the present work as it gives description of cyclone and flood hazard in South 24 Paraganas.

S.L. De, (1997), *Socio Economic Change in West Bengal: A Study of the Sundarbans Region*

The book discusses regional Profile of the Sundarbans which includes constraints and prospects of industrial growth, agriculture, fishing, animal husbandry, poultry farming and other activities. It also stressed on the developmental strategies like infrastructural development, need based education and training for socio-economic and all round development of the area. The book mainly helped to gather knowledge regarding agriculture and fishing activities and socio economic profile of the people of the study area.


The manual provides extensive information on the types of revetment available, and provides guidance on the choice and design of these systems. With regard to natural and artificial watercourses, information is included on revetments that incorporate some form of structural protection and revetments. It gives idea of protection of the area with vegetation to increase the environmental quality of the systems.


The book describes the overall physiography and socio economic environment of the island dwellers of the Sundarbans. The details of the history, evolution, types of settlements, population dynamics, migration history and pattern are all collectively discussed. This is also an extensive work about the Sundarbans Delta in general. A micro level analysis of population and human settlement of the area is shown. The author correlated the physical nature of the deltaic environment and the rural population in the study area.
H. Chattopadhyaya, (1999), *The Mystery of the Sundarbans*

The book deals with the history of culture and civilization in the Sundarbans. Land reclamation, settlement pattern, economic structure, socio economic livelihood of rural folk, mangrove forest and association of ecosystem people with forest and developmental policies maintained by the Sundarban Development Board are discussed clearly.


The paper provides tools for planning and provides solutions to combat coastal vulnerabilities in Indian part of the Sundarbans. The natural hazards like cyclone and storm surge disasters that occur in the Sundarbans are described. The paper mainly focuses on both engineering responses and public preparedness programs to such events. The paper contributed in the research work by giving valuable information regarding sea level change in the study area.

A. K. Mandal, (2003), *The Sunderban of India: A Development Analysis*

The book describes the geo ecological set up, socio economic and demographic description of the Indian Sunderbans. The author pointed out the programmes, policies, schemes required for the balanced development of the study area and ways for proper management of the fragile ecosystem by several measures are also highlighted.

S. Sengupta, (2005), *Sundarban Jib Parimandal* (in Bengali)

The writer of this book gave detailed description of the Sundarbans starting from the development of delta to description of geology, biodiversity and embankment breaching. The socio cultural issues are highlighted and impact of climate change on population is described.

A. Ghosh, (2006), *The Hungry Tide*

The Hungry Tide is a very contemporary story of adventure and unlikely love, identity, and history, set in one of the most fascinating regions on the earth. On the easternmost coast of India, in the Bay of Bengal, lies the immense labyrinth of tiny islands known as the Sundarbans. The Hungry Tide is a prophetic novel of remarkable insight, beauty, and
humanity that highlights social, economic, psychological issues with unique ecological set up.

**D. Jana (2008), *Srikhanda Sundarban* (in Bengali)**

The book includes a collection of articles which provides information on geology, hydrology, soil and other physical characteristics of the study area. Embankment breaching, land reclamation, migration of people and other descriptions are also provided in different articles of the book.


The volume deals with the growth of aquaculture farming and its impact on the ecosystem, biodiversity, land use change and human well-being. It raised serious questions on: social cost of erosion of biodiversity, land conversion, sustainability of aquaculture, and multi-stakeholder-oriented policy responses. It also describes the land use change and problems of biodiversity conservation.

**M. Chatterjee, (2010), *Chemistry of Mangrove Ecosystem of the Indian Sundarbans***

The author highlights the nature and properties of mangrove soil, importance of soil properties on occurrence of different mangrove species, nature of habitats of mangroves and chemistry of 71 Compartments less than 15 Blocks of the Sundarban Tiger Reserve. It generates information for the development of eco-friendly conservation of mangrove species in the study area.

**S. Chatterjee Sarkar, (2010), *The Sundarbans***

The book views that lower deltaic Bengal has always had a life of its own, unique in its distinctive natural aspect and social development. Geographical and ecological evidence indicates that most of the area used to be once covered with dense, impenetrable jungle even as patches of cultivation sprang intermittently into life and then disappeared. The book has explained a continuous struggle ensued struggle between man and nature in the lower deltaic Bengal.
P. Barua, (2011), *Ecology, Biodiversity and Pollution of Indian Sundarbans*

The author in this book has pointed out that high urbanization, industrialization & unplanned tourism posed a negative impact on the health of the aquatic system in and around the Indian Sundarbans. It becomes a threat for the existence of floral and faunal biodiversity. The book mainly focuses on the impact of urbanization on biodiversity.


The book shows that mangrove areas are an important media for transport of offshore nutrients, as they are the exporters of large amount of plant and animal detritus. Ever increasing destruction of mangroves and simultaneous conversion of land coupled with indiscriminate contamination of different xeno-biotics with water and soil by various means are affecting the ecological condition of this special ecosystem.

P. Giri, (2012), *Effects of Drivers Change on the Sundarbans: India and Bangladesh*

The book describes the prominent ecosystem of the Sundarbans Biosphere Reserve. The Tropical humid forest and the mangroves make the surrounding environment free from pollution. It also describes the critical threats, including shrimp farming, illegal felling of trees, poaching of wildlife, and oil pollution from barge traffic to the fragile ecosystems. The book also explains the impact of climate change and human intervention on natural ecosystem.

C. Sharmila, (2014), *Island Subsidence in the Sundarbans - A Myth or a Reality?*

In this book the writer argues that climate change and consequent sea level rise, accompanied by coastal erosion threaten the islands with complete destruction. The region is geomorphologically unstable and prone to tidal oscillations. Constant change in morphology and geotectonics is a common feature here so that the islands are repeatedly built and rebuilt. Existing islands disappear and new ones are born from time to time. Writer argues that in view of the vulnerable condition and the growing population of the region, certain remedies must be undertaken immediately. The vulnerability of people due to climate change is emphasized and the needs of review of present policies for people are discussed.
S. Rahman, (2014), **Saline Zone at the Sundarbans Mangrove Forest of Bangladesh**

The paper finds out that saline intensity exists in different rivers and canals of the Bangladesh Sundarbans. Results of different analysis depicts that saline intensity was much higher in south-western part, where it is moderate in north-eastern part of Bangladesh Sundarbans. Spatial variation of Ph characteristics, electrical conductivity, amount of NaCl (mg/L), Salinity intensity and water quality of the Sundarbans river systems are briefly discussed.

A. Mukhopadhyay, (2009), **Cyclone Aila and the Sundarbans: An Enquiry into the Disaster and Politics of Aid and Relief**

The paper aimed to enquire into cyclone Aila and govern mentality of aid and relief in the Indian Sundarbans. To understand the enormity of Aila’s devastation and the marginalization of the islanders, the author portrayed a picture of pre-Aila Sundarbans. He attempted this portrayal to argue that people living in this forested delta have remained marginalized, marginalization here being induced by governmental rationalities. Again he also focused on the Irrigation Department’s embankment building activities to show that even when people’s needs are addressed, the way service is delivered reduces the so-called beneficiaries to mere objects of governmental power.

P. Sarkhel, (2012), **Examining Private Participation in Embankment Maintenance in the Indian Sundarbans**

The study finds complementarities between returns from land and private conservation expenditures on river embankments in the case of the Indian Sundarbans. Households whose principal occupation is aquaculture commit more resources to embankment conservation than those in non-aquaculture occupations. The researcher also found conservation efforts to increase in all types of aquaculture plots irrespective of the distance from embankments, but such efforts unambiguously decrease for agricultural plots that are located at a distance from the embankments. However, when they factor in the heterogeneity of resource users within aquaculture households (in terms of land-holding), free-riding becomes a possibility in the case of canal-based aquaculture, which involves multiple users drawing water from a single source. In such cases, they find tail-enders with lower land-holdings contribute more towards embankment maintenance while those at the head-water with greater wealth as well as intense social networks free-
ride. There is an ambiguity, however, regarding the extent of strategic interdependence between the head-enders and tail-enders and the causal mechanism of free riding. Furthermore, when agricultural and aquaculture households are taken together, there is some evidence that public intervention in embankment maintenance crowds out private efforts.

N. Islam, (2008), Cultural Landscape Changing due to Anthropogenic Influences on Surface Water and Threats to Mangrove Wetland Ecosystems: A Case Study on the Sundarbans, Bangladesh

The aim of this study was to work on surface saline water modelling in the Sundarbans region and find a relationship between salinity intrusion and the cultural landscapes changing pattern in the mangrove wetland ecosystems. The researcher had collected data from river waters and changing landscapes field areas in the Sundarbans region. The study also deals with the problems with the current situation of the Sundarbans mangrove wetlands ecosystems. The problem analysis was done primarily from an ecological perspective. The research helps to have a better understanding of the Sundarbans coastal mangrove wetlands ecosystem. The impact of salinity on agricultural land use in the study area is better understood through the paper.

M. S. Islam, (2011), Biodiversity and Livelihoods: A Case Study in Sundarbans Reserve Forest, World Heritage and Ramsar Site

The study explores different approaches of livelihoods of forest dependents and compares their living standard in the Sundarbans. This research finds difference between the annual selling income (1481, 70 Euro) and net income (602, 14 Euro) from harvesting products of forest dependents. The research explores that the eco people of the area are not able to get actual benefit from the Sundarbans resources due to the fear of Water Hijackers. Forest staffs are also involved in illegal money collection and that led the lower income of forest dependents. For low income they borrow loan for their annual harvesting operation cost. Forest dependents also lose significant amount of money from their selling income for paying loan interest (loan provider takes average 8.29% interest from harvesting selling income). The research finds that the users are highly dependent on the Sundarbans for their livelihood. 89.76% of the total household income comes from forest resources. All households are dependent on the Sundarbans fuel wood for their fuel consumption. The paper shows if the forest dependents be free from the factors of water
hijacker, forest staff and loan interest their income will be increased 60.25% from present net annual income. The paper helps in the research as it gives an idea of forest association of people, problems faced by the ecosystem people and ways of management by the authority in the Sundarbans.

1.7.1 THE RESEARCH GAP

The literatures reviewed above have highlighted diverse aspects of research problems with pertinent objectives. Some of them have emphasized upon the aspects which have more physical environmental orientation with less importance on the social issues related to such physical issues and some have been emphasized more upon the social and economic aspects giving less weightage on the avenues of physical ecological forces that control the socio economic issues. Giving due importance upon all the explanations and analyses made by various researchers it is evident that a new research work can be spearheaded towards an integration of both the physical, economic, social and political aspects with holistic approach. The following diagram (Diagram No. 1.2) represents the research gap for which the present endeavour is a humble attempt to fill in the gap.

Diagram No. 1.2 Research Gap
1.8.0 LIMITATIONS OF SUCH STUDY

Each and every study suffers from some limitations. Thus no way a research can be treated as full-proof. Even if one particular small facet of the problem is made full-proof, it will invariably throw out some loose ends which the researcher may not be able to tackle.

One of the major limitations of such work is the probability of falling into the trap of empiricism and to regard all unsolved questions in the light of evidence valid only for the objectively defined space and time frame in the absence of any strong logical force in the theoretical construct of the study. It may be difficult to unearth universal truths from the evidences at hand. This problem cannot be entirely avoided because one has to proceed with whatever data is available instead of asking for a particular type of information and basing his conclusions on that.

For example, to perceive the impact of breaching both on the ecology and economy of the selected area, a researcher need the rate of breaching of the embankment and the events responsible for such breaching at regular interval. The information collected at a piecemeal nature may not give the actual temporal picture of impact. Thus it will be insufficient to reach a conclusion for the total area. Similarly the facts and figures of a space protected by embankment or the category of people suffering the impact may not be similar for others space or the same space in other time. Therefore drawing conclusion for one area may not be applicable for other. Above all, the social aspects of suffering in terms of stress and strain imposed by breaching cannot be quantified.

1.9.0 POSSIBILITIES CONTAINED IN SUCH STUDY

Though data constraints, empiricism, incomplete and imperfect quantification may reduce the importance of this study considerably, yet some of the advantages cannot be denied. One such advantage is that, in course of working on the problem, the researcher has to devote himself more and more to the process of understanding the basis of survival and continuation of the livelihood related to active delta estuarine environment where presence or absence of embankments has a crucial role in sustenance of life and starts appreciating the ways of living of these people and communicating the same to the other groups. It leads to a different kind of resource appraisal by taking into consideration the perception of the resident population. Ordinarily, speaking a particular practice in the
resource inventory of a small group of people may appear to be very insignificant to the people who are not conversant with their mode of life. But in reality the practice may carry enormous significance.

For instance, most researchers will not attach much importance on the collection and consumption of small fishes and green palatable nutritious wild vegetation from the rivers and lowlands near the embankments for the people facing acute economic hardship during breaching and rainy season. The protein content of those vegetables and small fishes and their relatively easy availability sustain the victims of breaching during their hours of crisis. There are enumerable similar instances which can be cited to show that the sustaining capacity of the undisturbed surface environment extends beyond our own capacity to quantify. Notwithstanding the imperfections of quantification, the range of afflictions as perceived by the local people is itself a revelation. Newer and newer information may come from different areas about the impact of and survival from hazards of tidal surge.

Thus such studies are not altogether devoid of positive findings which may help us to redress some of the miseries of the affected communities and to rebuild their economies.
REFERENCES


20. Intergovernmental Panel for Climate Change. (2007), Sea Level Rise due to Climate Change and its Impact upon Coastal Belt.


