

## **Vulnerability and Risk Assessment of Environmental Hazards –A Case Study Of Patharpratima Block, (Sundarban Delta Region) South 24 Parganas, West Bengal, India**

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**Abstract:** Like every natural phenomena, natural hazards are common occurrences which can distract, modify and influence the residential environment, economy society and culture as well. Hazard is thus regarded as the disaster situation, in which some risk of disaster exists because the human population has set itself in situation of vulnerability. The occurrence of hazard largely depends upon location of any region. Thus any region with a mere fragile physical location is more prone to hazardous situations. These regions are known as the vulnerable ones as all those are intensely used by human being. Vulnerability is both physical and social in nature. An assessment of the risks faced by any region thus gives an idea regarding vulnerability of the same. The present study is regarding the vulnerability and risk assessment of the Patharpratima block of South 24 Parganas district, West Bengal. In this study an attempt has been taken to bring forward how the block is vulnerable to certain natural threats which have been clearly explained by an assessment of the risks faced by the same. The major objective of this study is to find out the vulnerability of the study area, both environmental and social and providing an assessment of the risks faced by the block. It was found from the field visits and primary survey that, a number of initiatives have been taken on the part of the GP to protect the embankments but they are all in vain due to the incoming surges and tidal currents which is a very common feature here. It has also been assigned that though human being are continuously proving themselves better with the passage of time, still we are at the mercy of nature. Nobody can do anything when a cyclone or a flood strikes in. Thus, it is better to make ourselves more prepared to face the challenges so that at least some lives can be saved.

**Keywords:** *Natural hazard; Disaster; fragile environment; Vulnerability; Risk assessment,*

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### **I. Introduction:**

Hazard is an inescapable part of life. Acquaintance with hazards whether it is natural or manmade is a common affair. Many people use the term hazard and disaster synonymously. Though the two terms, hazard and disaster are closely related, they do not mean the same. Hazard has been defined as “A natural event” while the disaster is its consequence. A hazard is a perceived natural event which threatens both life and property....a disaster is a realization of the hazard”. A hazard is therefore potential for disaster. If a hazard hits an unpopulated area, it will not be considered as disaster, it will be considered as disaster only if life and property of the place is seriously damaged. Hazard is thus regarded as the disaster situation, in which some risk of disaster exists because the human population has set itself in situation of vulnerability. Vulnerability is broadly defined as the potential for loss (Mitchell, 1989). In other words, a vulnerable region means ‘how much danger that particular region faces’. Now, the question comes, how we can say that a region is vulnerable? Is it only the environmental threats prevailing there, or the impacts of natural hazards on the people which is making the society vulnerable? This brings forward two concepts, i.e. ‘environmental vulnerability’ and ‘social vulnerability’. Environmental vulnerability means, how much the region is fragile environmentally, i.e. the intensity and frequency of the environmental threats faced by the region. And Social vulnerability means susceptibility of the society to losses resulting from natural hazard occurrences. According to Susan L Cutter, “There is a potential for loss derived from the interaction of society with bio-physical conditions which in turn affect the resilience of the environment to respond to the hazard or disaster as well as influence the adaptation of society to such changing conditions.” This signifies the relation between environmental vulnerability and social vulnerability of any region. Thus it can be said that if a region is environmentally vulnerable, it is socially vulnerable too. Vulnerability of any region depends upon its location and physical characteristics (environmental vulnerability) and the level of socio-economic development (social development) of the same. So it can be said that a remote place with least developed infrastructure and significant dependency on natural resources is thus more vulnerable. In India there are many such places where infrastructure is least developed and henceforth socio-economic development is very low and people live in a fragile environmental condition. A sudden change in natural phenomenon creates catastrophe in such regions which makes it a vulnerable one.

**Vulnerability** of a particular region is not completely understood, until and unless an assessment of risk is performed. The two terms, vulnerability and risk assessment goes hand in hand. Risk assessment involves an

identification of hazards which may lead to disaster, an estimation of the risk of such events and an evaluation of the social consequences of the risk (Kates and Kasperson, 1983). In a nutshell it can be said that we can finally have a clear idea of the fragility of the region if we follow the above mentioned steps. Risk assessment thus proves the vulnerability of a particular region. The present study is regarding the vulnerability and risk assessment of the Patharpratima block of South 24 Parganas district, West Bengal. In this study an attempt has been taken to bring forward how the block is vulnerable to certain environmental threats which has been clearly explained by an assessment of the risks faced by the same. The following table gives us an idea regarding the most disastrous hazards which have occurred in the block.

**Table 1: Severe natural hazards in Patharpratima block**

Hazard	Year of occurrence	Area affected	Impact on people	Impact on livestock	Impact on infrastructure
Flood	1978	All the 15 Gram Panchayets under Patharpratima block	Severe	Severe	Damage of Kuchcha houses along the river banks, breaching of embankments
Cyclone	2006	All the 15 Gram Panchayets under Patharpratima block	Severe	Severe	Damage of houses both kuchha and pucca mainly the coastal ones and those near the river banks.
Cyclone (AILA)	2009	All the 15 Gram Panchayets under Patharpratima block, out of which G-plot, Brajaballavpur, Sridharnagar, Herambagopalpur and Achintyanagar GPs were severely affected.	Severe	Severe	Damage of dwelling houses, tube wells, school buildings, Anganwari Centers, Health Centers, breaching of embankments mainly in the coastal areas.
Drought	1998-99	All the 15 Gram Panchayets under Patharpratima block	Moderate	Moderate	Damage of crops due to dearth of water

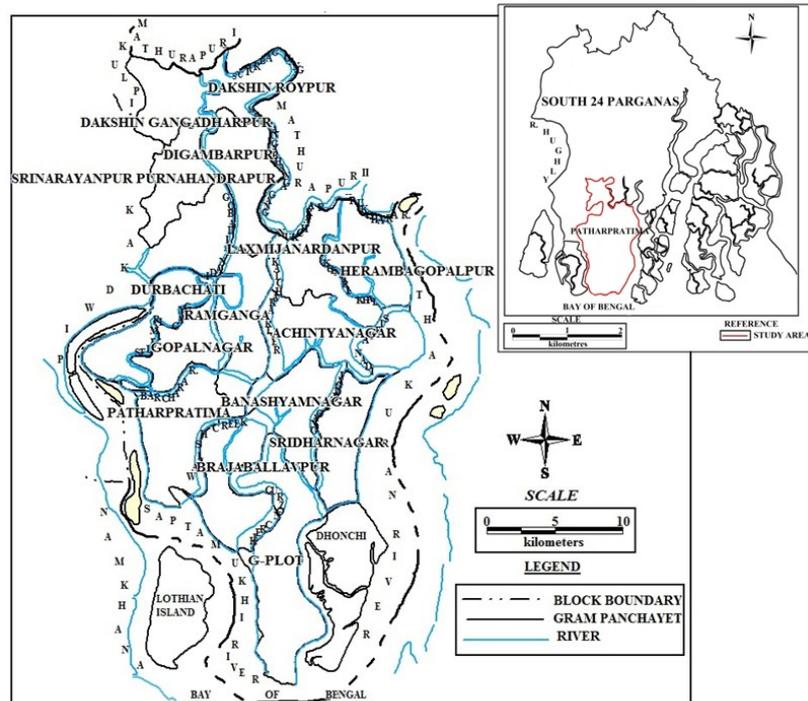
**Source: Block Disaster Management Plan, BDO, Patharpratima, South 24 Parganas (2011-2012)**

More or less the whole block is highly affected by severe cyclonic disturbances. Flood and tide water resurgences are the next violent hazards in the study area which also have disastrous impacts on the block. Both these hazards lead to destruction of life and property. Cyclones hit the block in the months of April, May and June that is during the pre monsoon period and also during October November and December i.e. in the post-monsoon period. Whereas flooding of the rivers takes place during the monsoon i.e. during the months of July, August and September and again during October and December. These two hazards have a disastrous effect on the block in every aspect, starting from the human life to livestock and infrastructure. There are certain consequences of flooding of the river channels which are so significant that they can be considered as hazards, separately. They are river bank erosion, salinization of the low lying coastal areas and breaching of the embankments due to tidal bore and storm surges. Although the Government reports thus obtained from the Hazard and disaster management Department of the Block Development Office says that the block has also suffered from drought too, but it has not been mentioned in this study as the impact of this hazard not that significant like the other two.

**Study Area:**

The Patharpratima C.D. block of Kakdwip subdivision is geographically located at the southernmost tip of West Bengal, covering an area of 484.47 square kilometer, surrounded by Namkhana, Kulpi, Mathurapur and Kakdwip blocks. The block consists of 15 GPs, 1Panchayet Samity and 92 registered villages and is located at the lower deltaic plain with 4m height above the msl. The GPs of the block, with its headquarter located at Ramganga, are Dakshin Roypur, Dakshin Gangadharpur, Digambarpur, Srinarayanpur - Purnachandrapur, Laxmijanardanpur, Herambagopalpur, Ramganga, Durbachati, Gopalnagar, Achintyanagar, Banashyamnagar, Patharpratima, Brajaballavpur, Sridharnagar, and G-plot (**fig. 1**). Due to its deltaic location, the block has been heavily dissected by the distributaries of river Ganga. The river network forms the major transport system of this block and people are dependent on the river both for transportation and livelihood (fishing). Between the large estuaries and rivers there are innumerable streams and water courses, called khals, forming a perfect network of channels, and ending ultimately in little channels that serve to draw off the water from each block of the land (O. Malley,1998). Being located in the deltaic region, the rivers here are tidal in nature and have ample supply of water all the year round. Breaching of river embankments, river bank erosion are thus very common phenomenon here. Typical southerly location of the block makes it prone to cyclones also. Depressions formed over Bay of Bengal affect the coastal regions heavily (Singh). All these natural calamities have an adverse effect

on the people residing there. Remoteness and undeveloped infrastructural facilities add to irreparable damages of life and property. Thus, the location and physical characteristics of the block itself makes it vulnerable.



**Fig. 01 – Location of the Study Area**

**Source: Compiled from Administrative Atlas (WB), DPM, NATMO and Census, 1961**

## II. Objectives:

The major objectives of this study is to find out the vulnerability status due to natural hazards of the study area, both environmental and social and providing an assessment of the risks faced by the block. Moreover intra regional disparity of extent of vulnerability is also to be considered in the core area of the objectives of the study. However, the functionalities of the major objectives of the research may be explained as --

- (i) To provide an account of the previous occurrences of hazards in the block and selecting the most frequent ones;
- (ii) To find out the possible consequences of the hazards;
- (iii) To identify the endangered river channels and creeks which are mostly vulnerable during storm flood;
- (iv) Also, to identify the most vulnerable areas in the studied area.

## III. Methodology:

Based on the settled objectives of the study, scheduled methods of investigation, analysis, interpretation and presentation are considered for the holistic study of the particular subjects. Basically, data and detailed reports of the hazards, collected by primary survey and partly from the Block Disaster Management Department (Patharpratima block). Specifically, an account of the history of disasters and their seasonality of occurrence in the block has been given. Depending on the frequency of their occurrences and severity, the most disastrous ones have been selected. In the next stage, their impacts and consequences have been mentioned, i.e. a detailed assessment of risks has been provided which is based on primary survey and ground truth verification. The major part of the study lies on risk assessment in which the explanation will be entirely rest on the details of the losses resulted due to the hazards. The consequences of the hazards have been described under the following three facts considering each hazard separately. Finally, impact analysis, respective presentation and inferences have been taken for suggestion.

- (i) Impact upon human life
- (ii) Impact upon livestock
- (iii) Impact upon infrastructure.

#### IV. Results And Discussions:

##### A. Cyclonic disturbances:

Bay of Bengal is one of the six major regions of the world which are responsible for the origin of tropical cyclones. The study area, Patharpratima block of South 24 Parganas district lies in the coastal region of the Bay. Henceforth, it is highly affected by the tropical cyclones originating in the Bay of Bengal. Here tropical cyclones become more disastrous natural hazards because of their high wind speed, high tidal surges, high rainfall intensity, very low atmospheric pressures causing unusual rise in sea level, and their persistence for several days. The total cumulative effects of high velocities of wind, torrential rainfall and transgression of sea water on to the coastal land become so enormous that the cyclones cause havoc in the affected areas and the ultimate result is tremendous loss of human lives and property (Singh). Gram Panchayets located more closer to the coast are naturally affected the most compared to those located closer to the main landmass. As mentioned earlier, an assessment of the risk faced by the block due to cyclonic disturbances has been done by describing the impacts of the hazard under the following heads.

##### (i) Impact upon human life:

A natural hazard is connoted as a disaster when its effect is havoc on human life. When large numbers of people exposed to hazard are killed, injured or damaged in some way, the event is termed a disaster (Smith). The catastrophe is severe in the GPs with a high population. From the primary survey of the local people, it was known that G-Plot GP, the GP with the highest population has faced the extreme devastation whenever cyclone has stroked the block. The map (Map No. 1) shows, the location of the GP which clearly depicts its suitability to be victimized by the cyclones developed over the Bay of Bengal. After this GP come the other southerly GPs like, Patharpratima, Achintyanagar, Sridharnagar, Banashyamnagar and Brajaballavpur. All these GPs have a high population compared to the rest of the GPs, Thus the impact of hazard is very vivid here too. Patharpratima block, located at the southernmost tip of the South 24 Parganas district is entirely rural in origin and is characterized with ill developed infrastructural facilities. Here majority of the population still lives on primary occupation like agriculture, collecting and fishing. Its riverine nature has aided the occupation of fishing largely. Thus many people have taken up fishing as their additional occupation. The total death toll and total number of lost people includes not only the people who are in the land, but also those who are at the sea or at the rivers and khals engaged in fishing i.e. the fishermen. In fact number of fishermen is high in total deaths and total lost. Fishing nets and country boats are used mainly for fishing as trawlers are not available in adequate numbers. Lack of modernized fishing facilities, aided with inadequate warning system leads to increase in the number of deaths. Patharpratima is located at the active deltaic region of the Ganga. And it is a characteristic of the deltaic formations that the banks of the rivers are higher than the adjacent lands. Thus these higher sides prevent the water from coming in to overflow the interior. These act as natural embankments which are again strengthened by artificial embankments. But cyclonic occurrences often breach these embankments and flood the interior lands. Quite obviously people residing closer to the rivers are endangered the most. Not only this, the incoming saline water of the sea floods the agricultural fields and marshes where shrimp culturing is practiced. Salinization of the agricultural fields and over flooding of the marshes caused great losses to the people who earn a living through those resources. This is a general observation in all the 15 GPs of the blocks (as found in personal interview of the village people and also from the reports obtained from the block). However the intensity varies within the GPs depending on their respective location and population. The following table shows the variation in impacts on the population under the categories of, High, Moderately High, Moderately Low and Low.

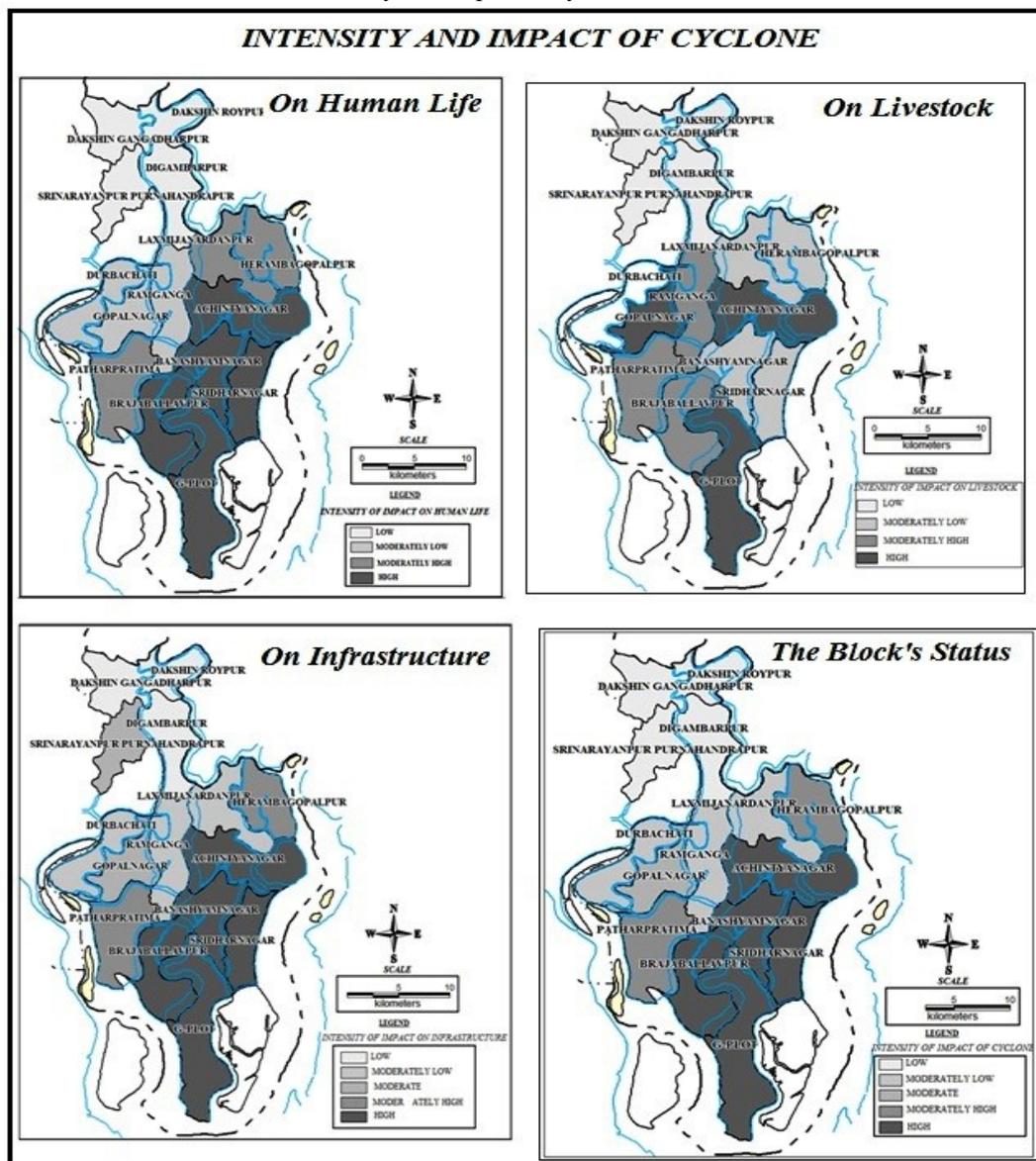
Table 2: Intensity of impact of cyclonic hazard upon human life

Name of the GP	Impact on human life
Dakshin Gangadharpur	Low
Achintyanagar	High
Banashyamnagar	High
Brajaballavpur	High
Dakshin Roypur	Low
Digambarpur	Low
Durbachati	Moderately Low
G-Plot	High
Gopalnagar	Moderately Low
Herambagopalpur	Moderately High
Laxmijanardanpur	Moderately High
Patharpratima	Moderately High
Ramganga	Moderately Low
Sridharnagar	High
Srinarayanpur-Purnachandrapur	Low

Source: Compiled by the authors

**(ii) Impact upon livestock:**

It has already been mentioned earlier that, people of Patharpratima block, still practices primary activities as means of living. Livestock rearing is thus very common here by which majority of the people earn a certain amount of their living. The major livestock that are reared here are cattle, sheep/goat and poultry. Livestock rearing is a common occupation in more or less most of the houses. Unlike the developed urbanized areas, these livestock are not much well kept and well maintained in the rural areas. Cattle are kept in small space beside the rural huts. These small spaces are nothing but enclosures, build up with straw thatches as roof-top and surrounded by sticks cemented with mud which act as walls. Quite naturally, these are not much resistant to furious cyclonic storms and hence are easily blown away. Most of the cattle die being buried under the falling roof and walls over them. Whereas poultry birds are kept in small cage like coops generally build of mud walls and straw thatched/asbestos roofs. A large number of poultry birds are kept together in a short congested place. So, when roof and walls collapse over them, total numbers of death increase. Many of the poultry birds are blown away too in gusty wind speed. Cyclone also brings along with it tidal bores which inundates the nearby lands. Many livestock are henceforth lost due to flooding of the lands also. The impact of cyclonic disturbances is widespread in the entire block, over all the 15 GPs, no doubt, but still there are variations in their intensity. The impact depends on the location i.e. closeness of the GP to the sea, mainly. The intensity of impact has been classified into four classes, High, Moderately High, Moderately Low and Low. The respective table explains the status classes of the GPs due to the intensity and impact of cyclone on the studied area.



*Calculated and Drawn by the Authors*

**Table 3: Intensity of impact of cyclonic hazard upon livestock**

Name of the GP	Impact on livestock
Dakshin Gangadharpur	Low
Achintyanagar	High
Banashyamnagar	Moderately Low
Brajaballavpur	Moderately High
Dakshin Roypur	Low
Digambarpur	Low
Durbachati	Moderately Low
G-Plot	High
Gopalnagar	High
Herambagopalpur	Moderately Low
Laxmijanardanpur	Moderately Low
Patharpratima	Moderately High
Ramganga	Moderately High
Sridharnagar	Moderately Low
Srinarayanpur-Purnachandrapur	Low

*Source: Compiled by the authors*

The above table shows the distribution of the GPs depending on the intensity of impact of cyclone on livestock. Likewise human population, impact on livestock is severe in places which have a comparatively large number of livestock populations and have a closer coastal location. However, one thing is to be observed here that all the GPs which faced severe loss of human life due to occurrence of cyclone, are not the same ones which have faced large number of death of livestock populations. In case of livestock population death, the number of highly affected GPs is low, compared to the less affected GPs. Thus it can be said that the impact of the cyclone is not much intense upon the livestock population. Figure no. 3 of Patharpratima block gives a picturesque description of the variation in intensity of impact of cyclonic disaster in the 15 GPs.

**(iii) Impact on infrastructure:**

Infrastructure of any region determines the level of development of the same. Impact of cyclonic disturbances is very vivid regarding the damaged infrastructure. Infrastructure of any region includes all the significant aspects and requirements of daily life. Here only the significantly damaged ones are being mentioned. They include, damaged buildings (both fully and partly damaged residential houses and other buildings), roads (mainly the mud roads and brick paved roads), embankments (length of damaged embankments), marshy land area (used for inland pisciculture). All these damages have been discussed separately and finally one final assessment has been prepared to highlight the extent of infrastructural loss GP wise.

**Breaching of Embankment:**

As already mentioned earlier, this block is riverine in nature and being deltaic in origin, is shaped like a saucer like the other Sunderban blocks. Rivers criss cross this block so extremely that embankment is a very important requirement to prevent the people and land from flooding. Vigorous cyclonic disturbances originating in the Bay devastates and creates breaches in the embankments time and again. The present situation of the embankment condition is given in the following table. The graph thus prepared shows the distribution of the length of the damaged embankments at Patharpratima block. Out of these 15 GPs the most vulnerable GPs, as mentioned by Irrigation Department of both Kakdwip and Jaynagore are, Brajaballavpur, Banashyamnagar, G-Plot, Achintyanagar, Ramganga, Herambagopalpur and Sridharnagar. In these GPs the embankments are continuously destructed even after repeated reconstruction, rendering them to be more endangered. There are certain points in these GPs which are washed by tidal currents regularly leading to creation of breaches in the embankment. Gradually the embankments break down along these breaches. The following table thus finally shows the intensity of impact of cyclonic hazard on embankments.

**Table 4: GP wise length of damaged embankment**

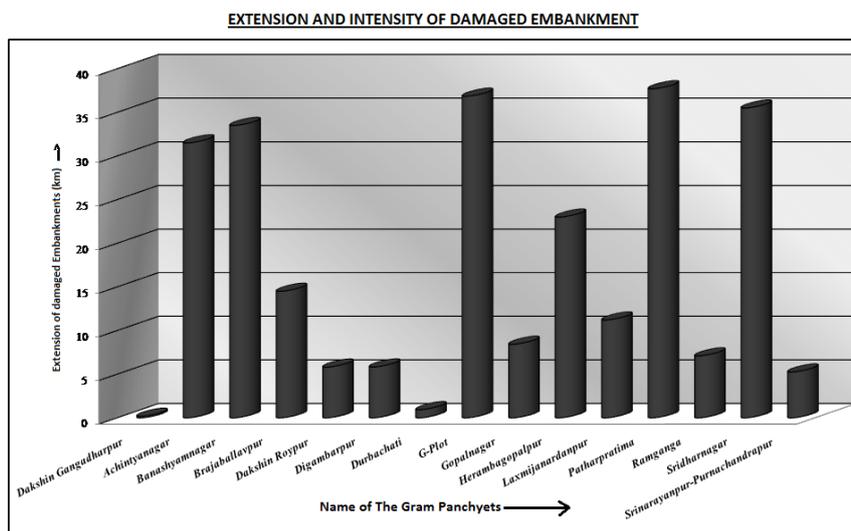
Name of the GP	Length of damaged embankment (in km)
Dakshin Gangadharpur	0.18
Achintyanagar	31.5
Banashyamnagar	33.5
Brajaballavpur	14.5
Dakshin Roypur	5.810
Digambarpur	5.825
Durbachati	0.935
G-Plot	36.850

Gopalnagar	8.430
Herambagopalpur	23
Laxmijanardanpur	11.21
Patharpratima	37.705
Ramganga	7.10
Sridharnagar	35.5
Srinarayanpur-Purnachandrapur	5.25

Source: Block Disaster Management Department, Patharpratima, South 24 Parganas, (2009)

**Housing and Building:**

The block, as already mentioned, is of rural origin. The number of pucca houses is much less compared to the kuchha ones. However, semi pucca houses are also observed. These houses have either mud built walls and tiled or straw thatched roofs, or cemented walls and tiled or asbestos roof. If one travel far interior, purely kuchha houses with mud and



thatched walls and straw thatched roofs will be a common phenomenon. Overall, it can be said that, the village houses are not so much resistant and soft and brittle materials are usually non-resistant to vigorous cyclonic disturbances.

**Table 5: Intensity of impact of cyclonic hazard on embankment**

Name of the GP	Impact on embankment
Dakshin Gangadharpur	Low
Achintyanagar	High
Banashyamnagar	High
Brajaballavpur	Moderately High
Dakshin Roypur	Moderately Low
Digambarpur	Moderately Low
Durbachati	Low
G-Plot	High
Gopalnagar	Moderately Low
Herambagopalpur	Moderately High
Laxmijanardanpur	Moderately Low
Patharpratima	High
Ramganga	Moderately Low
Sridharnagar	High
Srinarayanpur-Purnachandrapur	Moderately Low

*Calculated and Drawn by the Authors*

So, large number of village houses collapse and are devastated during intensive cyclones. The GPs with large number of kuchha houses therefore faces more devastation. Loss of housing properties, thus, does not depend much upon location of the villages, though, the houses located closer to the coast and embankments face the devastation first, if majority of them would have been resistant they would have withstand the effect much better. This could have resulted into less loss of life and property. Besides the destruction of residential houses many Government official buildings are also highly damaged in spite of being pucca in nature. They include both single and double storey buildings. These include Sishu Siksha Kendra, some ICDS centers, and some Primary Health Centers. However, the following table shows the variation in intensity of the impact of cyclonic disturbances on housing.

**Table 6: Intensity of impact of cyclonic hazard upon housing**

Name of the GP	Impact on housing
Dakshin Gangadharapur	Low
Achintyanagar	High
Banashyamnagar	Moderately High
Brajaballavpur	High
Dakshin Roypur	Low
Digambarpur	Moderately Low
Durbachati	Moderately Low
G-Plot	High
Gopalnagar	Moderately Low
Herambagopalpur	High
Laxmijanardanpur	Low
Patharpratima	Moderately High
Ramganga	Moderately Low
Sridharnagar	Moderately High
Srinarayanpur-Purnachandrapur	Low

**Source: Calculated and Drawn by the Author (Table- 5)**

**Village Roads:**

Rural roads in this block are mainly the mud roads and brick paved roads (both single soling and double soling). Metalled roads are less in numbers connecting only some major Government Offices and institutions like the Block Development Office, Block Primary Health Centre, Electricity Distribution Office, Patharpratima College and some Secondary and Higher Secondary schools. These metalled roads are only plastered roads, and not black topped ones generally built under the roads construction scheme of the GP or under MGNREG (Mahatma Gandhi National Rural Employment Guarantee) scheme. Only one black topped road is found here which connects this block with the rest of the district. It runs from Kolkata to Ramganga. There is one typical characteristic of the village roads found in this block. The embankments built along the rivers are modified to construct the roads. Sometimes they are either kept in the same status i.e. they are left as mud built tracks, or are paved with double soling bricks to form a somewhat better road which will last long. These roads perform a dual service, i.e. acting both as a road and as a support to the constructed embankment to make it strong and resistant to tidal currents. Muds built roads connect the villages with the main metalled roads which take them to the cities. Thus it can be said that mud roads form the major part of the village road network. But extreme cyclonic storms accompanied with heavy downpour completely wash away these mud roads resulting into disconnection of the interior parts of the villages with the major facilities provided by the block. Since number of metalled roads is less, it really brings in difficulty, to go to the interior parts of the villages. Thus the GPs with large number of mud road network face more difficulty than those having at least some metalled roads. The following table shows the variation in intensity of road damage in the 15 GPs of the block. It is to be observed from the above table that roads are more damaged in the GPs which have a closer coastal location. That means most of them are the roads built over the embankments. GPs with a larger areal extent faces huge loss as there are more number of villages which are connected to the metal roads through the mud roads and brick paved roads. GPs which are located further away from the block headquarter, Ramganga face a larger loss of road networks because much longer lengths of road networks are necessary to connect them to the headquarter. Larger the number of mud roads, more the loss.

**Table 7: Intensity of impact of cyclonic hazard upon roads**

Name of the GP	Impact on roads
Dakshin Gangadharpur	Low
Achintyanagar	High
Banashyamnagar	Moderately High
Brajaballavpur	High
Dakshin Roypur	Moderately Low
Digambarpur	Low
Durbachati	Moderately Low
G-Plot	High
Gopalnagar	Moderately High
Herambagopalpur	Moderately High
Laxmijanardanpur	Moderately Low
Patharpratima	Moderately High
Ramganga	Moderately Low
Sridharnagar	High
Srinarayanpur-Purnachandrapur	Moderately High

*Source: Calculated and drawn by the Authors*

**Marshy land areas:**

Like the rural areas, primary occupations are still in practice in this block. Out of which fishing and pisciculture is much in vogue? Being a deltaic region, large numbers of marshy land areas are found here. Some of these are natural while some are manually built up. Different species of prawn seeds are cultured here which have a very good market value in the cities. In fact, it can be said that many people earn a lump sum of money through this per year. Severe cyclonic storms followed by heavy rainfall for consecutive 3 to 4 or even more day’s damages these marshy lands. Fish and prawn seedlings cultured in these marshes flow out along with overflowing water and sometimes even are killed due to incoming salt water along with the rain water. Practicing of pisciculture is observed in more or less all the GPs. GPs with longer stretches of embankments face the loss of marshy lands more as salt water of the sea inundates these low lying lands through breached and damaged embankments. Small fishes and specially prawn seedlings cannot tolerate this excessively salt water and hence die easily. The following table shows the variations in extent of loss of marshy land areas used for pisciculture. The aforesaid observation and explanation thus gave an idea regarding the impact of cyclonic hazard on various inland services and infrastructure. Finally, in order to understand the impact on infrastructure more clearly all the four major infrastructures have been incorporated together through the extraction of composite matrix and thus presented the final status of all the Gram Panchayet. (fig. 4)

**Table 8: Intensity of impact of cyclonic hazard upon marshy land areas**

Name of the GP	Impact on marshy land areas
Dakshin Gangadharpur	Low
Achintyanagar	Moderately High
Banashyamnagar	High
Brajaballavpur	High
Dakshin Roypur	Low
Digambarpur	Low
Durbachati	Moderately Low
G-Plot	High
Gopalnagar	Moderately High
Herambagopalpur	Moderately High
Laxmijanardanpur	Moderately Low
Patharpratima	Moderately High
Ramganga	Moderately Low
Sridharnagar	Moderately High
Srinarayanpur-Purnachandrapur	Moderately Low

Source: Compiled by the authors

**Table 9: Intensity of impact of cyclonic hazard upon infrastructure taken as a whole** **Source:**

Name of GP(s)	Impact on embankment	Impact on housing	Impact on roads	Impact on marshy land	Composite status(impact upon infrastructure)
Dakshin Gangadharpur	Low	Low	Low	Low	Low
Achintyanagar	High	High	High	Moderately High	High
Banashyamnagar	High	Moderately High	Moderately High	High	High
Brajaballavpur	Moderately High	High	High	High	High
Dakshin Roypur	Moderately Low	Low	Moderately Low	Low	Low
Digambarpur	Moderately Low	Moderately Low	Low	Low	Low
Durbachati	Low	Moderately Low	Moderately Low	Moderately Low	Moderately Low
G-Plot	High	High	High	High	High
Gopalnagar	Moderately Low	Moderately Low	Moderately High	Moderately High	Moderate
Herambagopalpur	Moderately High	High	Moderately High	Moderately High	Moderately High
Laxmijanardanpur	Moderately Low	Low	Moderately Low	Moderately Low	Moderately Low
Patharpratima	High	Moderately High	Moderately High	Moderately High	Moderately high
Ramganga	Moderately Low	Moderately Low	Moderately Low	Moderately Low	Moderately Low
Sridharnagar	High	Moderately High	High	Moderately High	High
Srinarayanpur-Purnachandrapur	Moderately Low	Low	Moderately High	Moderately Low	Moderate

**Compiled by the authors**

Now to make a final assessment of the impact of cyclonic hazard in the 15 GPs a composite score matrix has been prepared which ultimately determines the status of the GPs regarding their vulnerability. The status classes thus obtained will actually determine the level of vulnerability of the GP to this particular hazardous phenomenon.

**Table 10: Intensity of impact of cyclonic hazard in the block**

Name of the GP	Impact on human life	Impact on livestock	Impact on infrastructure	Composite Status
Dakshin Gangadharpur	Low	Low	Low	Low
Achintyanagar	High	High	High	High
Banashyamnagar	High	Moderately Low	High	High
Brajaballavpur	High	Moderately High	High	High
Dakshin Roypur	Low	Low	Low	Low
Digambarpur	Low	Low	Low	Low
Durbachati	Moderately Low	Moderately Low	Moderately Low	Moderately low
G-Plot	High	High	High	High
Gopalnagar	Moderately Low	High	Moderate	Moderate
Herambagopalpur	Moderately High	Moderately Low	Moderately High	Moderately High
Laxmijanardanpur	Moderately High	Moderately Low	Moderately Low	Moderately Low
Patharpratima	Moderately High	Moderately High	Moderately High	Moderately High
Ramganga	Moderately Low	Moderately High	Moderately Low	Moderately Low
Sridharnagar	High	Moderately Low	High	High
Srinarayanpur-Purnachandrapur	Low	Low	Moderate	Low

**Source: Compiled by the authors**

Figure number 5 shows the impact of cyclone on the 15 GPs of the block. Banashyamnagar, Brajaballavpur, Achintyanagar, Sridharnagar and G-Plot GP are the worst affected ones. The impact is felt most as these GPs are farther away from the major facilities of the district and are also easily disconnected from the block headquarter due to lack of adequate infrastructural facilities. The GPs closer to the main landmass can feel the impact to a lesser extent as the people can avail the emergency facilities and move to safer inland areas earlier. This situation is exactly depicted in the above map. We can see that the intensity of cyclonic impact is gradually decreasing as one move to the northern inland areas. Dakshin Gangadharpur, Dakshin Roypur, Digambarpur and Srinarayanpur-Purnachandrapur GPs are the least affected ones instead of being criss-crossed by a large number of rivers and khals as they can avail the nearby helps and resources from the closer mainland. The impact upon Durbachati, Laxmijanardanpur and Ramganga GPs are moderately low whereas, Herambagopalpur and Patharpratima GP have moderately high impact. Only Gopalnagar GP has a moderate impact.

**B) Flood Hazards- Intensity and Impact**

After cyclonic disturbances the next significant hazard causing devastations in this block is Flood. Being located at the mouth of the river Ganga and a part of the Ganga- Brahmaputra delta, flooding of these low lands is quite a very common occurrence. The block, as already mentioned earlier, is heavily transected by large number of rivers and khals. Thus there is presence of estuaries and creeks which are funnel shaped. This typical physical characteristic of the block favours the occurrence of tidal bore which brings in heavy amount of sea water mainly during high tides. The GPs are so much dissected that they individually form an island themselves. Henceforth, these funnel shaped features are observed to a large stretch from the mouth to farther interiors. The GPs closer to the mouth are quite obviously affected more due to tidal bores, like, G-Plot, Patharpratima, Brajaballavpur, Banashyamnagar, and Ramganga GP. Besides this, another major reason for the occurrence of flood in this block is storm surge. Coastal areas are flooded by storm events at sea, resulting in waves overtopping defenses i.e. the embankments built along the rivers and creeks. A storm surge originating from cyclonic disturbance falls in this category. The embankments built here are also not very much resistant and thus breaches are easily formed in them which eventually results into breakdown of the embankments in the time being. Being located at the mouth of the Ganga, the volume of water is high in the river all the year round. This makes the rivers more dangerous and the mouzas more vulnerable to flood disasters. Like the other Sunderban blocks, this block resembles the shape of a saucer like feature. This means, the levee is at a much higher elevation than the adjacent flood plain. Thus quite obviously, when river water topples the embankments the water fills up the inner flood plain areas and does not drain away easily. This typical feature enhances the flooding of the block. Moreover, being the lower course of the river, deposition is very much active here. Repeated deposition of silt raises the bed of the river than the levee which forces the river water to overflow the flood plains. This occurs at times when there is excessive rainfall for a longer period of time. The rivers can no longer hold the excess amount of water and thus inundates the adjacent plains. The following table gives an idea of those rivers which have rendered certain GPs more prone to flooding. The related observation and analysis gives an idea of the endangered GPs and the rivers endangering them. This includes most of the rivers draining the block, which proves the vulnerability of the block to flooding. These rivers, creeks and khals carry large volume of water and inundate the low lying coastal areas during tides. They take a vigorous outlook during cyclones or even strong storms. The next table gives an idea of the level of vulnerability of the GPs by enumerating the total number of mouzas in them affected by flood.

**Table 11: Name of the vulnerable GPs in accordance with the name of the water bodies endangering them**

Name of the rivers/creek/khals	Vulnerable GPs
Thakuran	Achintyanagar, Sridharnagar, Herambagopalpur
Mridangabhanga	Ramganga, Laxmijanardanpur, Achintyanagar, Digambarpur
Shibua	Achintyanagar, Herambagopalpur
Jagaddal	Sridharnagar, Banashyamnagar, G-Plot
Pakhirali	Sridharnagar, Achintyanagar
Gobadia	Ramganga, Patharpratima, Digambarpur
Barchara	Ramganga
Shukha	Ramganga
Atharogachi	Laxmijanardanpur
Pukchara	Herambagopalpur
Kakmari	Laxmijanardanpur
Kalir Khal	Herambagopalpur
Kuemuri	Herambagopalpur, Laxmijanardanpur
Nukchara	Laxmijanardanpur
Kalna	Dakshin Gangadharpur
Bay of Bengal	G-Plot
Saptamukhi	G-Plot
Curzon Creek	G-Plot
Hatania-Doania	Brajaballavpur
Gazir Khal	G-Plot, Brajaballavpur
Chaltabunia	Patharpratima
Walsh Creek	Patharpratima, G-Plot

*Source: Block Disaster Management Department, Patharpratima, South 24 Parganas, (2009)*

**Table 12: GP wise total number of mouzas which are severely affected during flood**

Name of the GP	Total number of mouzas affected
Dakshin Gangadharpur	1
Achintyanagar	5
Banashyamnagar	3
Brajaballavpur	4
Dakshin Roypur	0
Digambarpur	3
Durbachati	2
G-Plot	7
Gopalnagar	3
Herambagopalpur	2
Laxmijanardanpur	6
Patharpratima	4
Ramganga	4
Sridharnagar	3
Srinarayanpur-Purnachandrapur	0

**Source: Block Disaster Management Department, Patharpratima, South 24 Parganas, (2009)**

The above table shows that G-Plot GP is the most vulnerable one to flood. This GP is located at the end most part i.e. at the tip of the block. Thus it suffers both the effects of tidal bore and storm surges which either breaks down the embankments or overtops those inundating large areas of land. Other highly affected GPs include, Laxmijanardanpur, Achintyanagar, Patharpratima, Brajaballavpur and Ramganga. These highly affected GPs are at a high distance from the district mainland. Thus the impact is felt tremendously as relief measures and aids supplied by the Government takes time to reach the inundated areas. The devastations have reached their maximum when the aids reach there. Since they are heavily dissected by river networks, they become completely disconnected during the occurrence of these hazards. Compared to these GPs, those which are at a closer distance to the mainland and also not that much dissected by river channels, have lesser vulnerability like Srinarayanpur-Purnachandrapur and Dakshin Roypur GP. The impact is also not very high as they are closer to the urban land areas and hence get the required aids much earlier compared to those at the interiors. However, the impact of flood is also being described under the following three heads, i.e. impact upon human life, impact upon livestock and impact upon infrastructure.

**(i) Impact on human life:**

It has already been observed that, the GPs which are suffering from cyclonic disturbances are also suffering from flood hazards mostly. Excessive tidal bores and storm surges generated from cyclonic disturbances accompanied by persistent low pressure results into flooding of the low lying areas. The block being excessively dissected by river channels, khals and creeks, death toll due to flood is obviously quite high here as flood affects both inland and marine population. All the GPs are more or less connected with the marine inflow through the channels, khals and creeks. Thus inundation of vast areas through sea water is natural. Flooding thus leads to damaging of lots of houses which ultimately leads to loss of large number of human lives. Large numbers of people are rendered homeless due to loss of their homes and properties. It has been assigned that the areas which are highly affected, fall within the GPs namely, Achintyanagar, G-plot, Herambagopalpur, Brajaballavpur, Laxmijanardanpur, Patharpratima and Ramganga. Each of these GPs is more or less surrounded by rivers or khals on almost all the four sides, thus resembling an island themselves. Typical saucer like morphological set up of these GPs enhances easy flooding of the land. Not only flooding of vast areas lead to death of a large number of people both residing away from the rivers and sea and those fishing in their vessels far away into the sea, but also leads to the occurrence of certain diseases which take a fatal outlook. Diseases like diarrhoea, dysentery, cholera, break out and take the form of a catastrophe. This spreads out rapidly over large areas through contaminated drinking water and also rotting dead bodies of both animals and human. Absence of proper disposal of the corpses rots them which are feasted upon by flies, mosquitoes and other insects. These easily contaminate the food and water which affects health very badly. Ill developed infrastructure of health facilities i.e. less number of medical aids worsens the overall situation further. Remote location of the affected areas poses difficulty for the institutional aids to reach them in time. People do not get the life saving drugs and clean drinking water, when they need it badly. This worsens the situation more increasing the number of death. Many lives could have been saved if the required aids have reached there at proper time. Inadequate number of health centers and their lack of facilities add to the situation even more. People have to depend upon the mobile health camps which are made there by the different social organizations, institutes, NGOs and Governmental bodies. But many lives are already lost when the helping ones have made their way to the affected places. Besides these another significant feature of this block is also worth mentioning.

It is animal attack. Mainly crocodile attacks and snake bites. Coastal salt encrusted land areas are home to different species of snakes, most of which are poisonous as is the characteristic of tropical reptiles. Flooding renders these animals homeless too, the consequences of which is faced by the people. The snakes and crocodiles come overboard along with flood water and endanger the lives of the people. People are bitten by snakes often which are fatal in most of the times; whereas crocodiles feed on them for their food. Henceforth, a large number of lives are also lost due to this reason. GPs with a closer coastal location are quite naturally the worst affected ones due to their remote location and lack of infrastructural facilities like that observed in G-Plot, Brajaballavpur and Sridharnagar GP. GPs which are surrounded by khals and creeks face the problem of animal attack mainly attack by crocodiles more, compared to the other GPs. People here are attacked by crocodiles which easily swim inland through the khals which are linked up with the inlets draining the interior of the GPs. This includes GPs like Herambagopalpur, Achintyanagar, Ramganga, Patharpratima and Banashyamnagar. However, a classification of the GPs has been attempted in order to find out the highly affected and the least affected GPs. The classification has been done under four heads namely, High, Moderately High, Moderately Low and Low.

Table 13: Intensity of impact of flood hazard upon human life

Name of GP	Impact upon human
Dakshin Gangadharpur	Low
Achintyanagar	Moderately Low
Banashyamnagar	Moderately Low
Brajaballavpur	High
Dakshin Roypur	Low
Digambarpur	Low
Durbachati	Moderately Low
G-Plot	High
Gopalnagar	Moderately Low
Herambagopalpur	Moderately High
Laxmijanardanpur	Low
Patharpratima	Moderately Low
Ramganga	Low
Sridharnagar	High
Srinarayanpur-Purnachandrapur	Low

*Source: Compiled by the authors*

The above table gives a broad classification of the GPs according to the intensity of impact of flood hazard over human population. The GPs with a closer location to the mainland are less affected as these places got the advantage of being served earlier by the rescue teams compared to those farther away from the mainland. Moreover they are also fed by better health and communication facilities which saved much of their lives. The GPs like Dakshin Gangadharpur, Dakshin Roypur, Digambarpur and Srinarayanpur-Purnachandrapur have faced less impact due to their closer location to mainland, but it is to be noticed that Laxmijanardanpur GP and Ramganga GP also have faced lesser impact in spite of their remote location and in spite of being surrounded by stream channels and creeks. This may be due to Ramganga being headquarter of the block have a direct link up with the district headquarter and is given prior aids before they reach the other GPs. Whereas Laxmijanardanpur GP instead of being surrounded by water channels on all the four sides is not that much affected as it is closer to the Mathurapur II block which favors it to get early assistance. This GP also can utilize its direct communication with the district headquarters. Thus closeness to the mainland reduces the impact of flood. Figure number 6 gives a pictorial description of the classification.

**(ii) Impact on livestock:**

Being rural in origin, livestock rearing is a priority in this block. People not only have their own livestock but also some of the families (mainly the Below Poverty Level families/ the BPL families) are also aided by the Panchayet to have cattle, sheep/goat and poultry. Either they are given cash, so that they can buy the livestock on their own or sometimes they are also given chicks/calves/kids so that they do not have to spend much in buying them from the market. Thus, it was observed that more or less all of the houses owned livestock and that also of good numbers, mainly the poultry. As according to them poultry keeping is less expensive compared to cattle keeping and gives a good return almost all the year round. Due to flooding of vast land area large number of livestock is lost as they are not well kept and their shelters are not well maintained. Most of them flow away in flood water and those stuck in their shades die getting choked in water flow. Besides this many of the livestock mainly the cattle and sheep/goat are devoured by crocodiles which come inland along with flood water. Snake bites are also a common phenomenon which leads to the death of many animals. After the flood water recedes another problem comes forth, i.e. some sort of epidemic which spreads through dead bodies of

animals. The dead bodies of animals rot away due lack of proper disposal and thus pollutes the surroundings, the germs of which are easily spread through flies and insects feeding over them. Livestock which had survived luckily also face death as they come in contact with the deadly diseases spread due to the dead bodies of the other animals. The following table gives an idea of the intensity of impact of flood upon the livestock population.

**Table 14: Intensity of impact of flood hazard upon livestock**

<b>Name of GP</b>	<b>Impact upon livestock</b>
Dakshin Gangadharpur	Moderately Low
Achintyanagar	Moderately Low
Banashyamnagar	Low
Brajaballavpur	Moderately High
Dakshin Roypur	Low
Digambarpur	Low
Durbachati	Low
G-Plot	High
Gopalnagar	Low
Herambagopalpur	Low
Laxmijanardanpur	Low
Patharpratima	Moderately Low
Ramganga	Low
Sridharnagar	Moderately High
Srinarayanpur-Purnachandrapur	Low

**Source: Compiled by the authors**

Although flood water engulfs large areas affecting the animal population and the livestock, the above table shows that loss of livestock is moderate in almost all the GPs. Only two of the 15 GPs are highly affected. Rest of GPs is moderately affected and most of them show a trend towards lesser impact. This may be due to presence of less number of livestock in the GPs. The following map gives a pictorial view of the impact of flood upon livestock population.

**(iii) Impact on infrastructure:**

As already mentioned earlier, infrastructure of any region is a very strong determinant of its development. It can be said that it forms the basic structure of a region’s future. A region would be attributed to be developed depending on the presence of two conditions, firstly, presence of good infrastructural condition according to the requirements of the inhabitants and secondly, resistivity of the available infrastructure, i.e. how much the infrastructure could stand hazardous situations. Infrastructure of a region, whether it is rural or urban, includes all the amenities of daily living. Here only those features are being discussed which have been severely affected by flood waters. Then finally a total assessment has been done to get an overview of the impact of flood hazard upon infrastructure. The discussed heads are as follows:

**Breaching of Embankment:**

In a riverine block, where all the GPs are surrounded by rivers, khals and creeks, embankments play a very important role in order to protect the inhabitants. Funnel shaped bays and inlets pose a very favourable situation for the tidal bore to come and devastate vast areas of land. Interlinkage of the rivers makes it easy for the flood water to reach further interior of the lands. Thus, those GPs which are far away from the sea also comes under the impact of incoming salty sea water. Large stretches of embankments are broken almost every year either due to fierce tidal bores or due to bank erosion. The following table gives an enumeration of the GPs which are endangered due to tidal bore and bank erosion.

**Table 15: Cause of damage of some severely flood affected GPs (source: BDMD, Patharpratima)**

<b>Name of the GP</b>	<b>Cause of embankment damage</b>
Brajaballavpur	River bank erosion and tidal bore
Banashyamnagar	River bank erosion
G-Plot	River bank erosion and tidal bore
Durbachati	Tidal bore
Ramganga	River bank erosion and tidal bore
Gopalnagar	Tidal bore
Patharpratima	Tidal bore
Laxmijanardanpur	Tidal bore
Sridharnagar	Tidal bore
Digambarpur	River bank erosion and tidal bore
Achintyanagar	River bank erosion
Herambagopalpur	River bank erosion

This reveals that tidal bore is more effective in this block than bank erosion. This is due to the typical location of the block in the Bay and its typical elongated shape which makes it easy to bring in the tidal currents of the sea through the inlets. This gets severe during the occurrences of cyclonic disturbances at the Bay which is a common incident here. Tidal waters easily reach the rivers along with the storm currents. An important fact needs attention here, i.e. it is noted from the above table that not only the seaward GPs are affected due to tidal bore, but also the GPs located towards the mainland, are also affected ones. This may be due to that fact that all the river channels are interlinked here and hence, the effect becomes widespread. Naturally, the severity is more towards the sea than towards the mainland. Being located at a deltaic region, these GPs face bank erosion almost all the year round, as the volume of water in the rivers is high at all the times which enhances the erosive capacity of the rivers. The following table shows the GPs which are the most vulnerable to bank erosion, the rivers endangering them and the corresponding damaged length of the embankments. The data thus given in the table are the more or less average lengths of the embankments per GP which remain endangered most of the times in a year and are under continuous monitoring of the irrigation departments of Kakdwip and Jaynagore.

**Table 16: Length of the severely damaged embankments of some selected Gps (By Primary Survey)**

Name of the GP	Name of the rivers	Length of the damaged embankments (in m)
Brajaballavpur	Bay of Bengal, Curzon Creek, Saptamukhi, Choto Rakshaskhali, Jagaddal	4700
Banashyamnagar	Jagaddal	300
G-Plot	Saptamukhi, Jagaddal, Bay of Bengal	5400
Achintyanagar	Thakuran, Shibua, Mridangabhanga	9700
Ramganga	Barchara, Gobadiya, Mridangabhanga	3250
Herambagopalpur	Pakchara, Nakchara, Thakuran	2000
Sridharnagar	Jagaddal	1500

Source: Block Disaster Management Department (BDMD), Patharpratima (2009), S. Twenty-four Parganas

Depending upon the derived data of the Irrigation Departments and from primary survey, the GPs have been classified into four categories namely, Low, Moderately Low, Moderately High and High to show the variations in intensity of damaged embankments. The following table shows the classification.

**Table 17: Intensity of impact of flood hazard upon embankment**

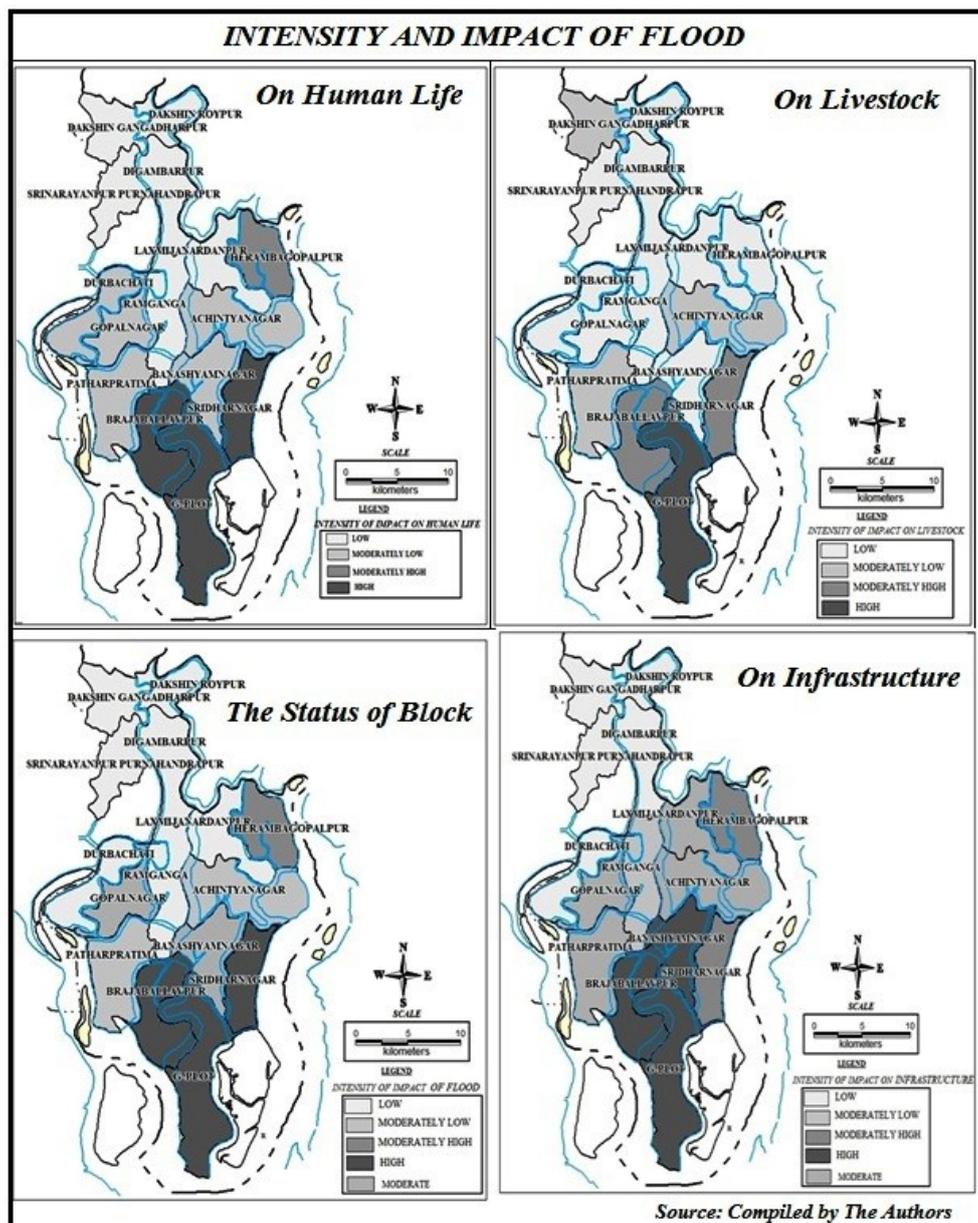
Name of GP	Impact upon embankment
Dakshin Gangadharpur	Low
Achintyanagar	Low
Banashyamnagar	Moderately Low
Brajaballavpur	Moderately High
Dakshin Roypur	Low
Digambarpur	Low
Durbachati	Moderately low
G-Plot	High
Gopalnagar	Low
Herambagopalpur	Moderately High
Laxmijanardanpur	Moderately Low
Patharpratima	Moderately High
Ramganga	Moderately low
Sridharnagar	Moderately High
Srinarayanpur-Purnachandrapur	Low

Source: Compiled by the authors

From the table it is clearly seen that embankment, is endangered in all the GPs. It can be concluded from the classification that loss of embankment is moderate in all the GPs whether it is high or low in intensity. Highest intensity is observed only in G-Plot GP and GPs like Brajaballavpur, Herambagopalpur, Patharpratima and Sridharnagar show a tendency towards high intensity of damaging embankments. GPs with low intensity are those which are located away from the sea like Dakshin Gangadharpur, Dakshin Roypur, Digambarpur, Srinarayanpur-Purnachandrapur, Gopalnagar and Achintyanagar. These GPs have a lesser stretch of embankment and thus suffer a less loss due to flood. GPs with a moderately low intensity are those whose condition is a little worse than the GPs with low impact.

**Impact on fishing:**

Typical deltaic location and presence of rivers has made fishing an important occupation here. After agriculture fishing is the second important occupation than service and the allied sectors. Good amount of monthly return has encouraged many people to take up aquaculture as a mean of good business. Thus both fishing and aquaculture are significantly high in this block. Income from fishing thus includes, both inland and marine fishing (in marine fishing crabs and other sea fishes are included which fetch a good amount of money in the city markets) and brackish water aquaculture (mainly variety of shrimps). Due to flooding of the inland areas the water bodies in which aquaculture is practiced, are severely wasted as they are filled up with salty sea water which endangers the fishes and shrimps present there. Flood water also comes in through the linkages with the water bodies and nearby rivers/creek. This leads to loss of tons of fishes. Thus, it can be said that impact of flood upon fishing comes under two heads, firstly, damaging of large number of water bodies practicing aquaculture and secondly, loss of tones of fishes. They are individually described below and depending on the intensity of impact of flood water the GPs has been classified under both the above mentioned two heads. Then finally one concluding classification has been prepared by taking the previous two classifications together.



**Table 18: Intensity of impact of flood hazard upon water bodies meant for aquaculture**

Name of GP	Impact upon water bodies for practicing aquaculture
Dakshin Gangadharpur	Low
Achintyanagar	Moderately Low
Banashyamnagar	Moderately High
Brajaballavpur	High
Dakshin Roypur	Low
Digambarpur	Low
Durbachati	Low
G-Plot	High
Gopalnagar	Moderately Low
Herambagopalpur	Moderately Low
Laxmijanardanpur	Low
Patharpratima	Low
Ramganga	Low
Sridharnagar	Low
Srinarayanpur-Purnachandrapur	Low

*Source: Compiled by the authors*

**Table 19: Intensity of impact of flood hazard upon total fish caught**

Name of GP	Impact upon total fish caught
Dakshin Gangadharpur	Low
Achintyanagar	Low
Banashyamnagar	Moderately High
Brajaballavpur	Moderately High
Dakshin Roypur	Low
Digambarpur	Low
Durbachati	Low
G-Plot	High
Gopalnagar	Moderately Low
Herambagopalpur	Moderately Low
Laxmijanardanpur	Low
Patharpratima	Moderately Low
Ramganga	Moderately Low
Sridharnagar	Moderately Low
Srinarayanpur-Purnachandrapur	Low

*Source: Compiled by the authors*

**Table 20: Intensity of impact of flood hazard upon fishery**

Name of GP	Impact upon water bodies for practicing aquaculture	Impact upon total fish caught	Impact upon fishery
Dakshin Gangadharpur	Low	Low	Low
Achintyanagar	Moderately Low	Low	Low
Banashyamnagar	Moderately High	Moderately High	Moderately High
Brajaballavpur	High	Moderately High	High
Dakshin Roypur	Low	Low	Low
Digambarpur	Low	Low	Low
Durbachati	Low	Low	Low
G-Plot	High	High	High

Gopalnagar	Moderately Low	Moderately Low	Moderately Low
Herambagopalpur	Moderately Low	Moderately Low	Moderately Low
Laxmijanardanpur	Low	Low	Low
Patharpratima	Low	Moderately Low	Low
Ramganga	Low	Moderately Low	Low
Sridharnagar	Low	Moderately Low	Low
Srinarayanpur-Purnachandrapur	Low	Low	Low

*Source: Compiled by the authors*

The above table shows the variation in intensity of impact of flood upon fishery taken as a whole of the two different but related factors. The GPs with a closer sea-ward location and larger stretches of water bodies and consequently large output of fish show a high impact compared to those away from sea and lesser output of product (here fish). But one thing is to be noted here that some GPs like Patharpratima and Ramganga in spite of their closer location towards sea do not show much loss. This may be due to lesser stretch of water bodies and also involvement of the people in other occupations like service and other job instead of fishing.

**Table 21: Intensity of impact of flood hazard upon drinking water**

Name of GP	Impact upon drinking water
Dakshin Gangadharpur	Low
Achintyanagar	Moderately High
Banashyamnagar	High
Brajaballavpur	High
Dakshin Roypur	Low
Digambarpur	Low
Durbachati	Low
G-Plot	High
Gopalnagar	Moderately Low
Herambagopalpur	Moderately High
Laxmijanardanpur	Moderately Low
Patharpratima	Moderately High
Ramganga	Moderately High
Sridharnagar	Moderately High
Srinarayanpur-Purnachandrapur	Moderately Low

*Source: Compiled by the authors*

The above table shows the impact of flood upon drinking water in the GPs. It reveals that almost all of them have moderate to high impact upon drinking water. Excepting some GPs which are closer to the district mainland, all are affected. Water being the most important requirement of daily life, the impact upon it is also very widespread.

#### **Impact on Transport and Communication:**

In this rural block, mud roads and brick paved roads form the main network of connectivity. Mud roads are still larger in number than that of brick paved ones and no doubt from the black topped roads also, which are of least numbers. Flood water washes away these mud roads and thus hinders the communication. Here in this block there is no such specialized drainage facilities like the urban areas which help in draining out the flood waters. The only way out is the rivers and creeks. The rivers being full during the floods are also not able to carry this excess amount of water in them and hence the villages remain in a water logged situation for a long time. The people have to wait for the water to move out naturally as no artificial means can be adopted. This water logging situation deteriorates the condition of both the mud roads and the brick paved roads tremendously. The brick paved roads (both single and double soling) are binded with mud and hence they are also affected by the flood water as the mud washes away due to such long stay of water in one place. However the following table shows the variations in intensity of impact of flood upon the road networks in the 15 GPs. Now a final enumeration of the impact of flood upon the infrastructure of the block will be done by including all the above discussed factors i.e. impact upon embankment, fishery, drinking water and roads.

**Table 22: Intensity of impact of flood hazard upon roads**

Name of GP	Impact upon roads
Dakshin Gangadharpur	Low
Achintyanagar	Moderately High
Banashyamnagar	High
Brajaballavpur	High
Dakshin Roypur	Low
Digambarpur	Low
Durbachati	Low
G-Plot	High
Gopalnagar	Moderately High
Herambagopalpur	Moderately High
Laxmijanardanpur	Moderately High
Patharpratima	Moderately Low
Ramganga	Moderately Low
Sridharnagar	Moderately High
Srinarayanpur-Purnachandrapur	Low

**Source: Compiled by the authors**

**Table 23: Intensity of impact of flood hazard upon infrastructure taken as a whole**

Name of GP	Impact upon embankment	Impact upon fishery	Impact upon drinking water	Impact upon roads	Impact upon infrastructure
Dakshin Gangadharpur	Low	Low	Low	Low	Low
Achintyanagar	Low	Low	Moderately High	Moderately High	Moderate
Banashyamnagar	Moderately Low	Moderately High	High	High	High
Brajaballavpur	Moderately High	High	High	High	High
Dakshin Roypur	Low	Low	Low	Low	Low
Digambarpur	Low	Low	Low	Low	Low
Durbachati	Moderately low	Low	Low	Low	Low
G-Plot	High	High	High	High	High
Gopalnagar	Low	Moderately Low	Moderately Low	Moderately High	Moderate
Herambagopalpur	Moderately High	Moderately Low	Moderately High	Moderately High	Moderately High
Laxmijanardanpur	Moderately Low	Low	Moderately Low	Moderately High	Moderate
Patharpratima	Moderately High	Low	Moderately High	Moderately Low	Moderate
Ramganga	Moderately low	Low	Moderately High	Moderately Low	Moderately Low
Sridharnagar	Moderately High	Low	Moderately High	Moderately High	Moderately High
Srinarayanpur-Purnachandrapur	Low	Low	Moderately Low	Low	Low

**Source: Compiled by the authors**

The above table shows the classification of the GPs according to the intensity of impact of flood on infrastructure. In this classification we have got five classes instead of the four classes into which we were first classifying the GPs. The five classes thus derived are Low, Moderately Low, Moderate, Moderately High and High (Fig no. 8). After the detailed discussion of the impact of flood on the three important factors - human, livestock and infrastructure- composite indices have been prepared to find out the impact of flood as a whole on the 15 GPs. The following table shows the classification which has been finally depicted (Fig. 9).

**Table 24: Intensity of impact of flood hazard in the block (Source: Compiled by the authors)**

Name of GP	Impact upon human	Impact upon livestock	Impact upon infrastructure	Composite status
Dakshin Gangadharpur	Low	Moderately Low	Low	Low
Achintyanagar	Moderately Low	Moderately Low	Moderate	Moderately Low
Banashyamnagar	Moderately Low	Low	High	Moderate
Brajaballavpur	High	Moderately High	High	High
Dakshin Roypur	Low	Low	Low	Low
Digambarpur	Low	Low	Low	Low
Durbachati	Moderately Low	Low	Low	Low
G-Plot	High	High	High	High

Gopalnagar	Moderately Low	Low	Moderate	Moderate
Herambagopalpur	Moderately High	Low	Moderately High	Moderately High
Laxmijanardanpur	Low	Low	Moderate	Low
Patharpratima	Moderately Low	Moderately Low	Moderate	Moderately Low
Ramganga	Low	Low	Moderately Low	Low
Sridharnagar	High	Moderately High	Moderately High	High
Srinarayanpur- Purnachandrapur	Low	Low	Low	Low

The above table shows that the impact of flood is moderate in all the GPs on an average. Brajaballavpur and G-Plot GP are the highly affected ones and the least affected ones are those GPs which are closer to the mainland. There are certain GPs also who inspite of their southerly location are not that much affected, this may be due to a little better infrastructural situation present there and their closeness to block headquarter at Ramganga.

### V. Findings and conclusion:

The study has been done in much detail regarding the vulnerability of the block to natural hazards. That the GP is very much prone to both cyclone and flood, as a consequence of cyclone, is very much clear from the above discussions and maps. However, again a table is being provided below to show the vulnerability of the GPs to these two natural hazards individually. Though it is a repetition, still, it will help us in finding their proneness to these two hazards separately.

Table 25: GP wise intensity of impact of cyclone and flood hazard in the block

Name of GP	Impact of cyclone	Impact of flood
Dakshin Gangadharpur	Low	Low
Achintyanagar	High	Moderately Low
Banashyamnagar	High	Moderate
Brajaballavpur	High	High
Dakshin Roypur	Low	Low
Digambarpur	Low	Low
Durbachati	Moderately Low	Low
G-Plot	High	High
Gopalnagar	Moderate	Moderate
Herambagopalpur	Moderately High	Moderately High
Laxmijanardanpur	Moderately Low	Low
Patharpratima	Moderately High	Moderately Low
Ramganga	Moderately Low	Low
Sridharnagar	High	High
Srinarayanpur-Purnachandrapur	Moderate	Low

**Source: Compiled by the authors**

The study thus shows that impact of cyclonic disturbances is more compared to the impact of flood in the GPs. Quite obviously the GPs located closer to the mainland are less affected, by both the hazards compared to those closer to the sea. These GPs (here, Dakshin Gangadharpur, Dakshin Roypur, Srinarayanpur-Purnachandrapur, Digambarpur and Durbachati) have a better communication with the headquarters and other important centers of the district, which has helped them to overcome the disastrous situations unlike the other GPs which are much remote. The detail discussions reveal that G-Plot, Brajaballavpur, Banashyamnagar and Sridharnagar GPs are the highest affected ones both due to cyclone and due to flood. These four GPs are located at the end of the block with the G-Plot GP being in the lap of the Bay, which makes it more vulnerable to the natural hazards. Physical characteristics and typical location of the GPs have rendered them more prone to the impact of natural hazards.

Embankments play several significant roles in protection of life and property in these GPs. But a frequent occurrence of cyclonic disturbances and flood creates breaches in them and thus endangers life. Though all the cyclones are not much severe always, still as they form frequently, their impact is felt widely. It was found from the field visits and primary survey that, a number of initiatives have been taken on the part of the GP to protect the embankments but they are all in vain due to the incoming surges and tidal currents which is a very common feature here. Trees of mangrove variety are planted along the embankments under the Mahatma Gandhi National Rural Employment guarantee Scheme by the village people themselves almost every year. But before these trees grow up fully, they are cut off by the people living there by the river side. The reason for such a behavior, is that, they think that Government is forcefully encroaching upon their land and thus they are just clearing their own land. This typical behavior of the people indicates their ignorance and illiteracy. Thus it can

be said that they are endangering their own life. Natural hazard prone areas should have good resistant buildings so that not much life is lost during the occurrences of hazards. But in this block, I came across people who bear a typical illogical thought regarding building pucca houses. They believe in staying in mud built kuchha houses and saving money for future use. The people, whose houses were completely demolished in cyclone (aila), were given Government aid (financial) so that they can build their houses. But the original fact is that, they have built the same mud built straw thatched huts, resulting into continuation of risk of life during severe hazards. It can also be assigned that though human being are continuously proving themselves better with the passage of time, still we are at the mercy of nature. Nobody can do anything when a cyclone or a flood strikes in. Thus, it is better to make ourselves more prepared to face the challenges so that at least some lives can be saved.

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