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Impact of Cyclone Aila on Land Use and Its Management in Haripur

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ABSTRACT:

Aila the most devastating severe cyclone was hit the Bengal coast which is under Indian Sundarban on 25th May, 2009. It destroyed the both natural and manmade environmental system. It also affects land use of the Indian Sundarban. This paper aimed to find out the effects of Aila on land use and related problems, to examine the management of land use. Under observational study design, descriptive study has been applied for this study. The study area Haripur is located in western bank of Saptamukhi River in South Western Sundarban a part of Namkhana block was also affected very extensively. It is a part of Haripur Gram Panchayet. In this study cadastral map has been used for plot to plot survey to explore land change. Landsat –TM satellite image has been used to delineate the flood area through by Image processing software QGIS-2.14.10. During the survey and field visit some peoples and local surveyors were surveyed for plot to plot land use category identification. Primarily land use categories were plotted on cadastral map and since that final land use map has been prepared by author. After all author is belongs to the study area. So his observation and knowledge about the study area Percentage analysis has been used through MS Excel for analysis of changing land use. The result shows that almost 2200 people were affected by Aila. Both natural and cultural recourses have been affected. Some drastic phenomenon like salinization, embankment breaching and land use change have been raised. The major changed land use categories are agricultural land, fisheries, settlement, water bodies and wasteland. Percentage analysis shows that agricultural land decreased but finally it has been almost recovered and going back to its previous place. Fisheries, settlement, water bodies and wasteland have been increased in post Aila situation with respect to pre Aila situation. People started to manage the problems related to land use change. Most of the cases they got success. People also are struggling to overcome such problems till now.

KEY WORDS: Mouza, Embankment breaching, Land use, Management.

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INTRODUCTION:

Broadly speaking land use means the use of land. The term may be defined as the putting up of a land for any purpose. Land use may be practiced in a very intensive way. It is the result of scarcity. There are many causes to change the land use. One of the important is environmental disasters make changes on land use.

Several researches conducted to assess the impacts of Aila. Roy, Mehedi, Sultana, and Ershad¹ initially assessed the impacts of Aila and important damage sectors. Baten² assessed the impacts of Aila in Khulna and Satkhira district of Bangladesh after one year of Aila and the author mentioned that impacts were on infrastructure, lives, agriculture and livestock, drinking water, food and nutrition etc. Halder³ discussed about the impact of Aila on land use pattern. He identified the changes of land use pattern due to Aila. He analysed the wide range of impacts of Aila on land use. Jahan⁴ emphasised on the livelihood, drinking water, household, food and education. Sharmin and Naznin⁵ studied on Impacts of Cyclone Aila on Educational Institutions: A Study of South-Western Bangladesh. Mukherjee et al.⁶ examined the effect of a catastrophic cyclone (Aila) on estuarine fish assemblages in a tidal river like Matla River of the Sundarban Delta. Debnath⁷ attempted to assess the impact of Aila on village level agricultural productivity in Gosaba, CD block. Moniruzzaman, Rahman and Siddik⁸ investigated the disaster impacts at household level due to Cyclone Aila; and to assess recovery nature of the victim families (at household level) in the study area after four years of the event. Kabir, Russell⁹ studied on the impact of cyclones Aila on the health of the coastal people of Bangladesh. Kabir, Salehin and Kibria¹⁰ find out the short term and prolonged impacts associated with the physical hazard in one severely cyclone-Aila affected southwest coastal polder. The study also involved to assessing the resulting impacts on livelihood activities. The study showed that duration of inundation and consequent degradation of soil quality has been the major determinant of adverse impacts on agricultural farmers, with loss of capital and reduced access to social resources compounding the negative impacts on the livelihood activities, while prolonged inundation had similar impact on fish farming (both shrimp cultivation and sweet water fishing). Kar and Bandyopadhyay¹¹ assessed the Impact of Aila in Gosaba CD block through remote sensing technique and they also have shown the land use change temporally after Aila on Gosaba block. Chakraborty¹² evaluated the impact of severe cyclone Aila in Sundarban area of West Bengal. Mallick, Ahmed and Vogt¹³ pointed out in his research paper that the cyclone Aila killed and injured people, damaged houses, damaged the roads, collapsed the embankments, destroyed or damaged the schools in South-Western Coastal Region of Bangladesh. Khatun et. al¹⁴ studied that fishing, agriculture, shrimp farming, salt farming and tourism are the main economic activities of this

coastal area of Bangladesh destroyed by Aila. Some of the organizations of India like Sphere India¹⁵, Adventist Development and Relief Agency¹⁶; European Commission Humanitarian Aid Organization¹⁷ have also find out the impacts of Aila in India.

STUDY AREA:

Administratively the study area Haripur mouza (Figure-1c) is located within Haripur Gram Panchayet under Namkhana police station (Figure-1b), in South 24 Parganas district of West Bengal (Figure-1a), India. It was the worst affected area due to Aila. The area of affected part is 310.72 hectares or 1935.25 bigha (1 hectares = 6.23 bigha). The study area extended in latitude from 21°37'00" N to 21°38'56" N and in longitude from 88°16'36" E to 88°17'55" E. The Saptamukhi River boarded the east of this area. North, West and South side of this area are bounded by Ainsley Creek, Maharajganj and Debnibas and Bijoybati mouza. There are embankments along the creek and river. Haripur was reclaimed in the third phase (1873-1931) of the reclamation process. This area was part of formerly named Machlenberg Island¹⁸ in 1903 when Sir Andrew Freser (Lt. Governor of Bengal, 1903) came here. Average altitude of this area is less than 3 meter above mean sea level. This area is built with unconsolidated alluvium or mud and Saline alkali soils with mud. The mean summer temperature is 33.5⁰ and mean winter temperature is 18⁰C. Average annual rainfall is 1700 mm.

OBJECTIVES:

The objectives of this study is to put the focus and attention on the changing land use of this area due to tropical cyclone Aila and management procedure that has been followed by the people to overcome the problems.

MATERIALS AND METHODOLOGY:

The study is based on both primary and secondary data. To complete the objectives of the study the whole work has been divided into three stages: (1) Pre-field study: Literatures, relevant information from newspapers, various reports published by different government and Non-government Organizations were studied. Some secondary data had been collected from India Meteorological Department etc. Cadastral maps published by Govt. of West Bengal and Satellite image (LANDSAT –TM, captured 26th May, 2009) from United States Geological Survey web portal (Figure 3) had been collected for this study specially to detect the flood area and embankment breached parts as materials. (2) Field Study: As the author belongs to the study area, land use data were collected vary precisely from the field by plot to plot survey through conversation with the affected people, local surveyor and ground inspection. Breached embankment portion inspection,

new embankment construction observation and shifted embankment part observation by the researcher were also done in this phase. All field data have been compiled and superimposed on the cadastral map during field survey by conversation with local surveyor and inhabitants of the study area. During the field visit household surveys and discussion were done by simple conversations to understand the pre – during – post disaster situation and recovery management from this problem. (3) Post field study: In this phase collected maps on which field data were plotted are scanned and digitized by GIS platform (QGIS 2.14.10). After that pre and post Aila land use maps have been prepared. Another map also prepared from satellite image to show the inundated area by saline water due to flood. Google Earth image of different year had been used and compared to detect the specific land use changes. At last collected information and data, prepared maps have been analysed and interpreted.

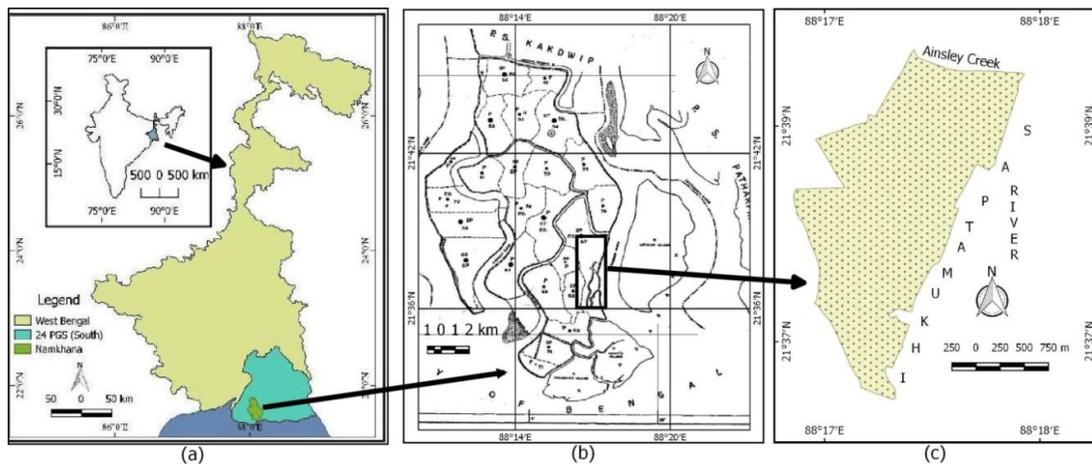


Figure 1: Location of the study area

RESULT AND DISCUSSION:

Effect of Aila:

Aila was land fall at mid noon time. During the disaster, embankment was breached and high tidal water with high salinity started to flow to the interior parts of this mouza and over flowed rest of the embankment. The affected numbers of people were about 2200. There was only one victim death. Agricultural land converted into waste land and unfertile land caused by continues inflow of high tidal saline water to agricultural land.

Among the major consequences, destruction of house and changing land use character are very important. Total 609 houses had been damaged but among these 456 were fully damaged and rest were partly damaged. Property like crops (Rice 200 acre, Chilli 20 acre, Till 1 acre), fish (30000INR), domestic animal (no data) etc were also destroyed.

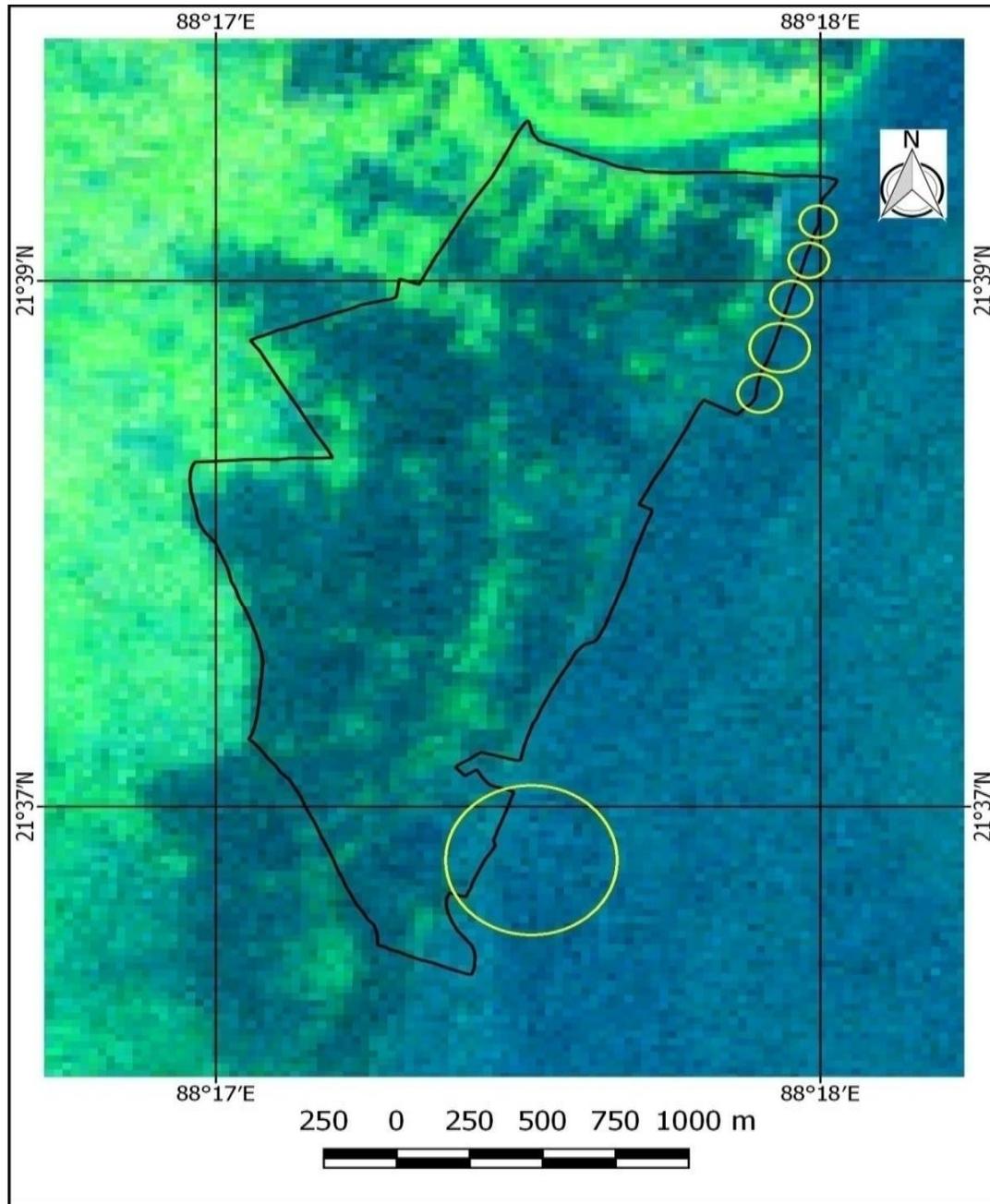


Figure 2: FCC Landsat 5-TM satellite image captured in 26th May, 2009.

(Source: USGS web platform).

East side of Haripur mouza is covered by embankment of Saptamukhi River. Length of the embankment of breached portion is 1300 metres. North east part and east part near the sluice gate (Pancher Gheri) and south eastern part of the embankment had been breached. Breached parts were made by very loose materials like brick, particles and clayed soils. So the total area inundated and flooded by chaste level saline water. As the flood was occurred in day time, so the people came out

from their house reached to elevated interior earthen roads. Water was logged for 4-5 months creating uncultivable land and temporary fisheries.

Salinization resulting from water logging destroyed the capability of agricultural land and domestic usable ponds water, fish ponds fresh water quality. Almost 600 Fish pond salinised. After Aila people used fresh water ponds in the upper part of the mouza, where saline water cannot reached in which place on pond used for 100 people and also people (average pond area 160 square feet) used water for the domestic animal. As the total area was covered by saline water, so fresh water crisis had been extensively raised for 1 year after Aila.

As the agricultural land was not able for cultivation to produce crop, so peoples were migrated to Kolkata, Malda, and Trakeswar for daily job for 3-5 months.

Land use Change:

Haripur is a reclaimed area in Namkhana block. The reclamation¹⁹ process had been completed during the period of 1872-1939. Before reclamation, this area was covered by mangrove forest and few tidal creeks. Since the reclamation this area became settled with build fish pond and bounded river side by earthen embankment. Then agricultural land use was introduced in this time. So in this way land use pattern was initiated in Haripur mouza by immigrated people from adjacent districts.

Pre-Aila Land use:

This area²⁰ is very high efficiency region in land use area of Haripur mouza. It was affected by Aila. Most of the land of this area is used for agriculture and second position of land use category is in housing estate. Other land uses are water bodies, fisheries, wasteland and school (Figure 3).

In this area, before Aila the most of the land was mono crop land. The types of crops were highly productive, such as Aman (paddy), Boro (paddy) and chilli. Other crops like Khesari, Til, Sunflower are winter vegetables are cultivated in very small areas. In autumn Amon was cultivated all over the agricultural land and in Rabi season Boro and Chilli with other major crops are cultivated. But after Aila it is completely changed.

Post Aila Land use:

After Aila land use characteristics have been changed. People had used agricultural land for pisciculture. In 2009 rice cultivation has not been done. Cultivators were tried to plough seeds on agricultural land in 2010. But plants were disappeared due to high salinity of soil and drought condition. Cultivators had turn on in 2011 and started to rice cultivation due to normal rainfall. So

they needed almost two year to return earlier fully fledged rice cultivation. Here year wise land use changes have been discussed in following way (Figure 3).

Agricultural land:

Before Aila agricultural land was 268.02 hectare, but in 2011-12, post Aila agricultural land decreased to 245.78 hectare. Preceding agricultural land converted into other land. The result shows that water bodies, settlement, and wasteland were increased due to conversion of agricultural land by local people. When new concrete embankment constructed, required soil for embankment constriction had been collected from agricultural land. So, agricultural land has been transformed to water bodies. Former agricultural land also has been converted to wasteland because of continuous saline water effect. Agricultural land area was decreasing gradually after Aila up to 2014. In 2015-16 economic year agricultural land amount was almost 81.6% among the all land use category after Aila. So it can be say that agricultural land has been starting go back its earlier phase. The total statistics of agricultural land use change given in Table 1.

Causes of agricultural land changed:

As the old embankment was breached out by Aila storm surge, the concrete embankment (new) has been built over the agricultural land. As the embankment has been built on the river side of the old embankment, so soil of the agricultural land was cut for the built purpose and to do high of embankment. On the other hand after Aila the saline water covered all over the area and soil salinity increased rapidly. In spite of this embankment did not build until now, so at the any high tide situation like as full moon or black moon this areas is inundating till now. This condition has seen in the southern part of the mouza. So this area has converted into waste land. No crops were cultivated here. Now building concrete embankment foot breath is 130 feet. So it is captured the large amount of agricultural land.

Fisheries:

The land use category as fisheries covered 1.76% area before Aila and this percentage was same up to 2011-12. Then fisheries have been increased 1.84% area in 2013-14 and 2.43% in 2015-16. The cause of this is people are not interested in agriculture. So, they have converted agricultural land to fisheries.

Settlement:

Settlement area was 6.34% before Aila. After Aila this category of land use has been increased slightly. It has been increased just 1% from 2008-09 to 2015-2016. Some settlements are shifted from river embankment to interior land because of vulnerability of cyclone and flood.

Wasteland:

Before Aila 1.66 hectare wasteland which was covered 0.53% area was seen, but post Aila waste land has been increased for 2011-12 and 2013-14. But it reduced again to new water bodies and agricultural land. Waste land was increased due to disappointed of agricultural land. Constraints of cultivation converted agricultural land to wasteland temporarily.

Water bodies:

A massive increased area in water bodies has been observed after Aila. Before Aila 4.97% area was covered by water bodies. It has been increased to 8.11% area in 2015-16. When embankment building process started, required soil for embankment had been collected from agricultural land. Embankment was shifted towards agricultural land. So, agricultural land decreased due to water bodies. That is why water bodies have increased after Aila.

Temporary Fisheries (short term land use):

As during Aila all over the area was inundated by saline water. But after Aila this saline water could not be drain out due to lack of proper drainage system. In water logged portion, people bounded own land plot by net and collected saline fish like *Tanagra*, *Bhetki*, *Parse*, *Pabda*, *Bhangar* etc., which are to come in this water logged area by high tidal saline water from river.

Post Aila Land washed out:

Before Aila total land was 310.72 hectare. After Aila 2.5 hectare has washed out to the river Saptamukhi. So, post Aila total land is 308.22 hectare.

Post Aila crop pattern:

Table 1: Land use before and after Aila

Land use pattern	Year							
	2008-2009		2011-2012		2013-2014		2015-2016	
	Area in hectares	Area in (%)						
Agricultural land	268.02	86.25	245.78	79.10	242	78.51	251.51	81.6
Fisheries	5.49	1.76	5.49	1.76	5.7	1.84	7.5	2.43

Settlements	19.72	6.34	20.52	6.60	21.5	6.97	22.5	7.29
School	0.36	0.11	0.36	0.11	0.36	0.11	0.36	0.11
Waste lands	1.66	0.53	14.59	4.69	14.59	4.73	1.7	0.55
Water bodies	15.47	4.97	23.98	7.71	24.07	7.80	25.01	8.11
Total	310.72	100	310.72	100	308.22	100	308.22	100

Post land uses have been changed very prominently. There crop pattern have extensively changed, some of the crops such as Khasari, Til, Watermelon cultivation have been stopped. Chilli cultivation has completely depreciated.

LAND USE MANAGEMENT:

Post Aila land use is extensively changed. So, to reduce the problem some suggested relevant expedient have been taken by cultivators through their positive restless effort and suggestive measure of Local government, NGOs. The following points are relevant to this.

- i. Immediately construction of river embankment with proper scientific technology and engineering plan has been completed for the protection from inundation by saline water. The new embankment²² has height of 16 feet, base of 130 feet, river side slope 1:4 and opposite slope of 1:2.
- ii. Mangrove again visualized after Aila in the east side of embankment. This new mangrove may protect embankment from destructive waves in high tide time (Figure 4).
- iii. Sluice gate has been reconstructed for removing excess rainwater and for preventing ingress of saline water in to the interior land.
- iv. Existing drainage system has been reformed to remove water through sluice gate.
- v. Excavation of main and secondary drains to drain out excess rain water from deferent parts of areas through sluice gates.
- vi. Land has been properly leveled for the prevention of accumulation of rainwater for cultivation purpose and to facilitate uniform drainage of excess water.
- vii. As after one year also of Aila the crops production was very low, so soil has been tasted to suitable cultivation and necessary actions have been taken by people for cultivation.
- viii. Salinity tolerant HYVs (Highly Yielding variety) seeds have been distributed among the cultivators for agricultural purpose.
- ix. Paddy is the main crop for the farmers and chilli is the second main crops in Kharif and Rabi season respectively. So the selection of species was very important. Cultivators selected local varieties of species like Dudheswar, Palai etc. for cultivation for their salinity tolerant

capability and productivity. The other high yielding species were Nanisri, N-72, Hazar-17, Patnai, Bhasamanik, Damodar Sadamota etc.

- x. Rain water harvesting was very important at that time. Rain water has been stored by people of this area in ponds with proper plans to utilize the water for Rabi season.
- xi. Boro paddy cultivation for short duration seed varieties have been selected by cultivators with the help of suggestion of local government and NGOs. How chili cultivation would be started, the management process has not been started. Cultivators could not find out the solution.
- xii. People have started green chillis replaced by red or dry chillis. They have started sun flower cultivation in Rabi season replaced by Khesari. Mustered etc.
- xiii. Modification of method of agricultural system must be made and Rabi seasons other crops like tomato, sunflower can be cultivated.
- xiv. Ultimate Government should be cooperating with cultivators for sustainable utilization of land. So that land use management will be successful and every part of the land and also be used. Land use back to return to before condition.
- xv. At last it has to be Present condition is improved but not good as well. In Figure 5, a-2006 the satellite image is showing agriculture activity was active before Aila, b-2010 image shows land totally salinized and c-2015 image shows agriculture returned back its previous condition. The Figure also shows the Yellow circle indicates land was present before Aila but blue circle shows land has been washed out to Saptamukhi River after Aila. So ultimately agriculture got its previous environment as it was before for cultivation. People became almost successful to recover the land use.
- xvi. People of this area gave self efforts to manage the land use after Aila. They have used more and more indigenous species than HYV for monsoon paddy cultivation. At last they got tremendous yield rate. However the heavy rainfall 2011 has helped them to reduce the constraints of agriculture.

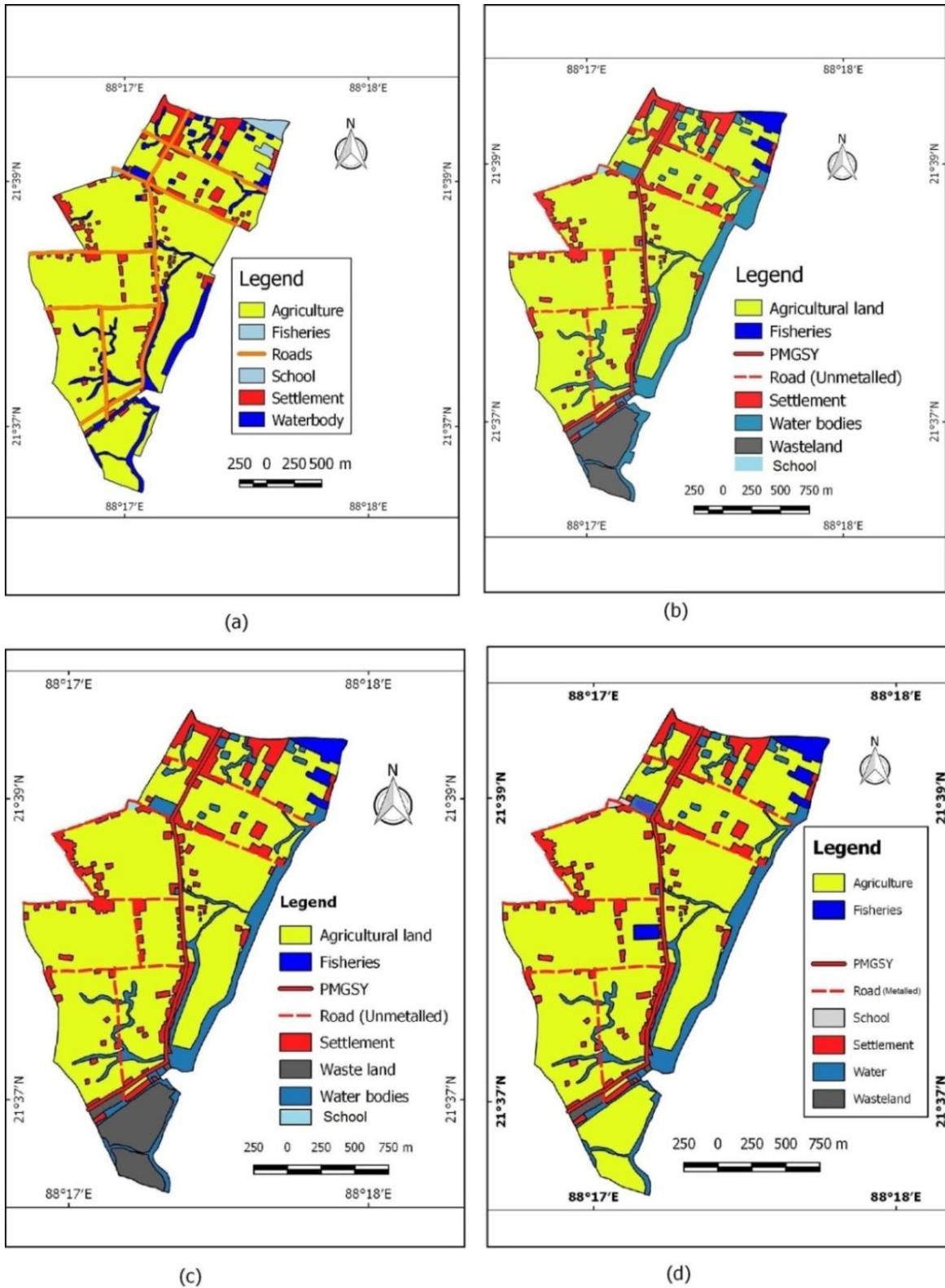


Figure 3: Year wise Land use change: (a) 2008-09, (b) 2011-12, (c) 2013-14, (d) 2015-16

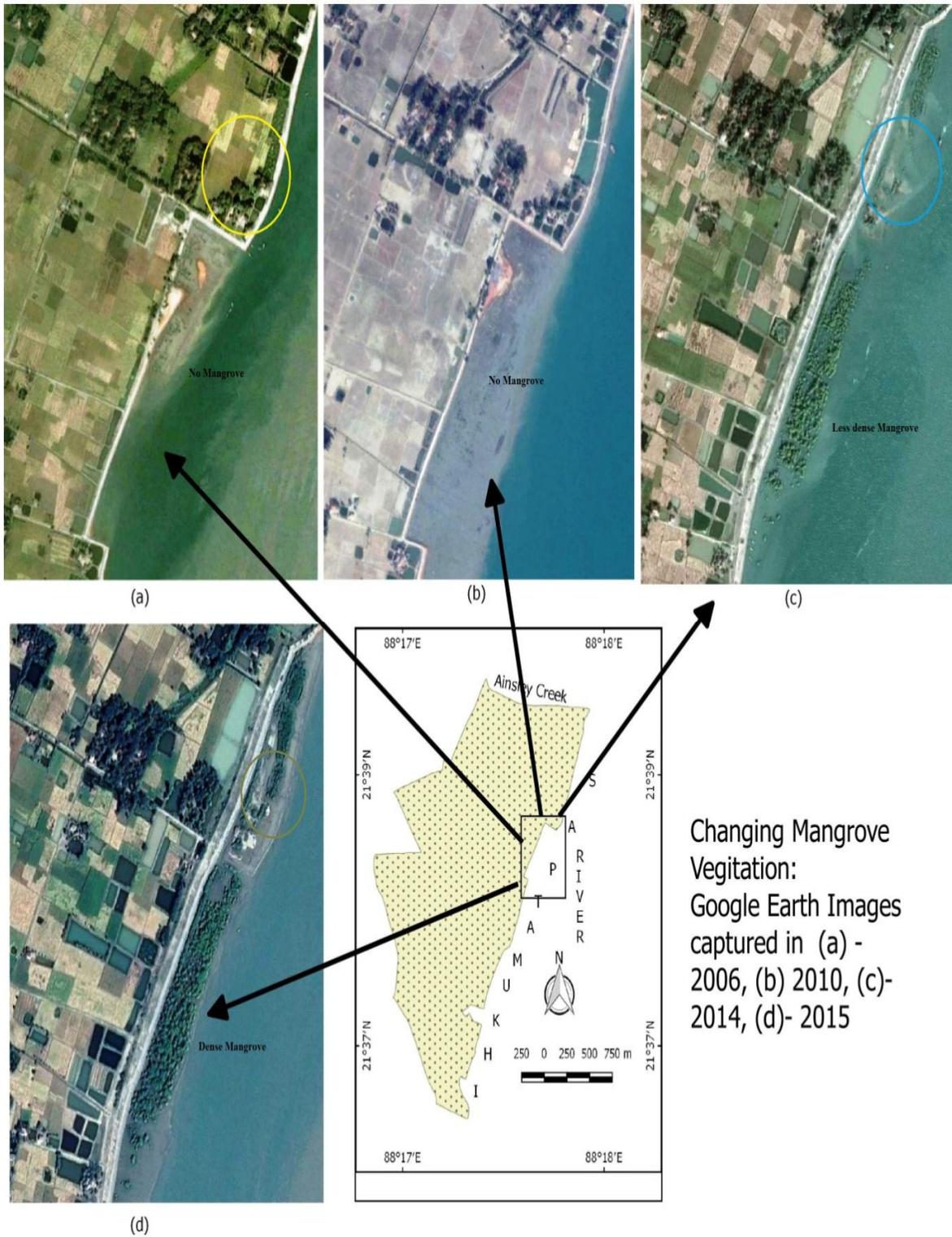


Figure 4: Changing mangrove for protection of embankment (Source: Google earth pro)

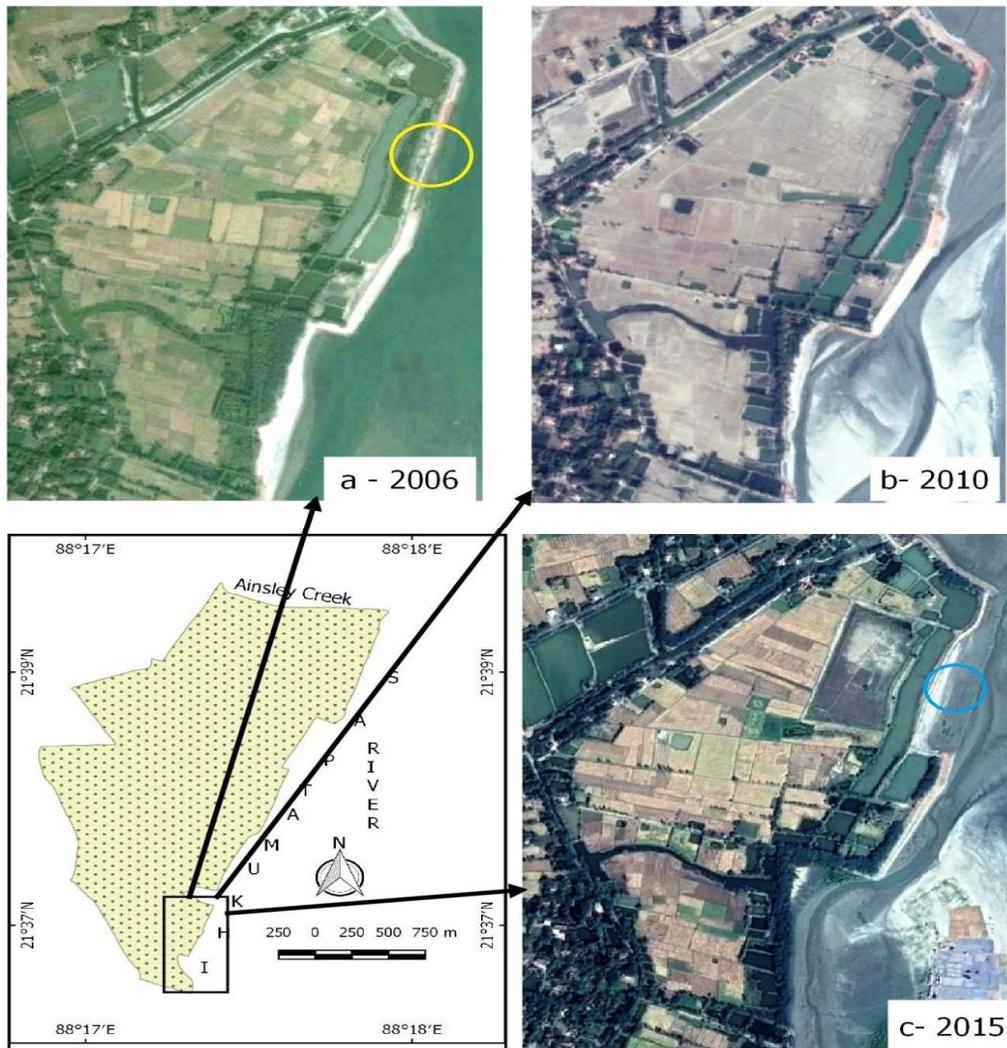


Figure 5: Land use recovery through management.

CONCLUSION:

Land use of the Haripur was affected by Aila like other effected components. The above result and discussion shows that agricultural land category is the most important land use category which affected and changed for short interval like 2 to 3 year, but it has been come back its previous stage. Water bodies have been increased, but the positive impact is that people are using these water bodies for fishing related economic activity. Management processes which have been applied by people through interaction and direction of Government and NGOs played vital role to this recovery. Victims have recovered their loss very well. It is said that saline water flood area land use problems take much time to recover basically in respect to Sundarban. But here it has been proved and also can be concluded that saline water flood area can recover very rapidly if the right decision is made by people and proper management process used after disaster.

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