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Seasonal Hydrological Characteristics of Langolhata Wetland of Birbhum District and its impact on Agricultural

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ABSTRACT

Wetlands are fundamental hydrologic landscape unit that generally forms on flat areas, or on shallow slopes, where perennial water lies at or near the land surface, either above or below. Wetlands tend to form where surface water and ground water accumulate within topographic depressions of different Geomorphological environment. The surface hydrological characteristics of langolhata wetland is controlled by the amount of rainfall, no of rainy days, height & width of water of Kuya river and sinuosity of the river. In this study rainfall and river water fluctuation is positively correlated with the wetland hydrology and both Kuya river and Kandar Khal have Sinuosity Index as 1.5 which indicate both the river is meandering in nature as well as narrow cross sectional width result into low water holding capacity of the channel which cause overflow towards the Langolhata wetland. The impact of wetland on agricultural pattern varies between flood year and non-flood year. During the flood year almost all the area of wetland is submerged and the standing crops are being lost. In non-flood year waterlogging also occurs due to some other hydrological parameter. It covers only part of wetland when the remaining area is used for cultivation. Moreover during post-monsoon period when the spatial extension as well as the height of the water has decreased, then the post-monsoonal crops are cultivated with the aid of surface water irrigation.

1. Introduction

Wetlands are a fundamental hydrologic landscape unit (Winter, 2001) that generally form on flat areas, or on shallow slopes, where perennial water lies at or near the land surface, either above or below. Wetlands tend to form where surface water and ground water accumulate within topographic depressions, such as along flood plains, within kettles, potholes, bogs, fens, lime sinks, pocosins, Car-olina Bays, vernal pools, pantanos, tenajas, and playas, and behind dunes, levees, and glacial moraines.

Langolhata wetland is a flood plain wetland located in Labpur block in Birbhum District which is lying under lower kopai river basin. There are 29 villages surrounding this wetland and therefore seasonal surface hydrological characteristics influence the agricultural pattern during both Monsoon and post-monsoon periods of that region. The seasonal surface hydrological pattern of this wetland is strongly controlled by different hydrological parameter like fluctuation of Kuya river (Name of Kopai river in lower part), fluctuation of rainfall during monsoon, sinuosity of the river, width of the river and water discharge

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capacity of the river. The present study objectives are to find out the seasonal hydrological characteristics of Langolhata Wetland during Monsoon and post-monsoon period as well as in flood year and non-flood year.

Secondly, to show the agricultural scenario of the wetland in response to seasonal hydrological characteristics of Langolhata Wetland, and thirdly, to suggest sustainable managerial measure for proper cultivation of crops in the Wetland mainly during the time of Monsoon.

2. Description of the study area

Langolhata wetland is located in the eastern part of the Labpur block between the border of Birbhum and Murshidabad district. The absolute location of this wetland is between 23°46'39" N to 23°49'47"N and 87°53'00"E to 87°57'19"E. The area of this wetland is about18.31 Km^2 which covers about 7% area out of total area of the block.

Topographically, this wetland is a part of lower Kopai river basin flood plain with very mild slope. Pedologically, thick alluvium soils of recent origin covers almost the whole area. Hydrologically, seasonal water logging condition exists here. Seasonality of rainfall i.e. intensive rainfall during monsoon period makes an adverse flood situation almost in every year. Topographical situation of the study area has shown here by the contour map of fig 2. in which a low land can be marked at the eastern part of the wetland.

3. Data base and Methodology

Most of the data upon which the present work has done are the primary data collected through empirical survey and perception survey and some secondary data like agriculture have collected from Agricultural Development Office, Govt. of West Bengal of Labpur Block as supporting facts. To show the correlation between wetland and other hydrological parameter simple methods of correlation (After Pearson's Product Moment Correlation) and correlation matrix has been employed.

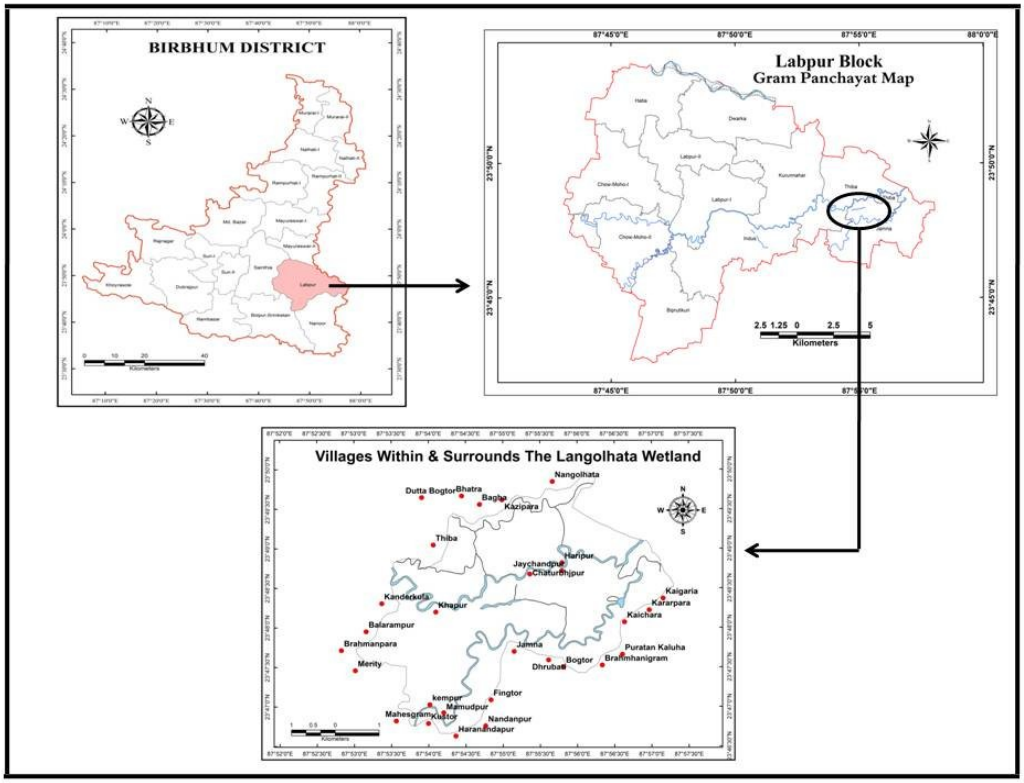

Fig. 1 Location of Study Area

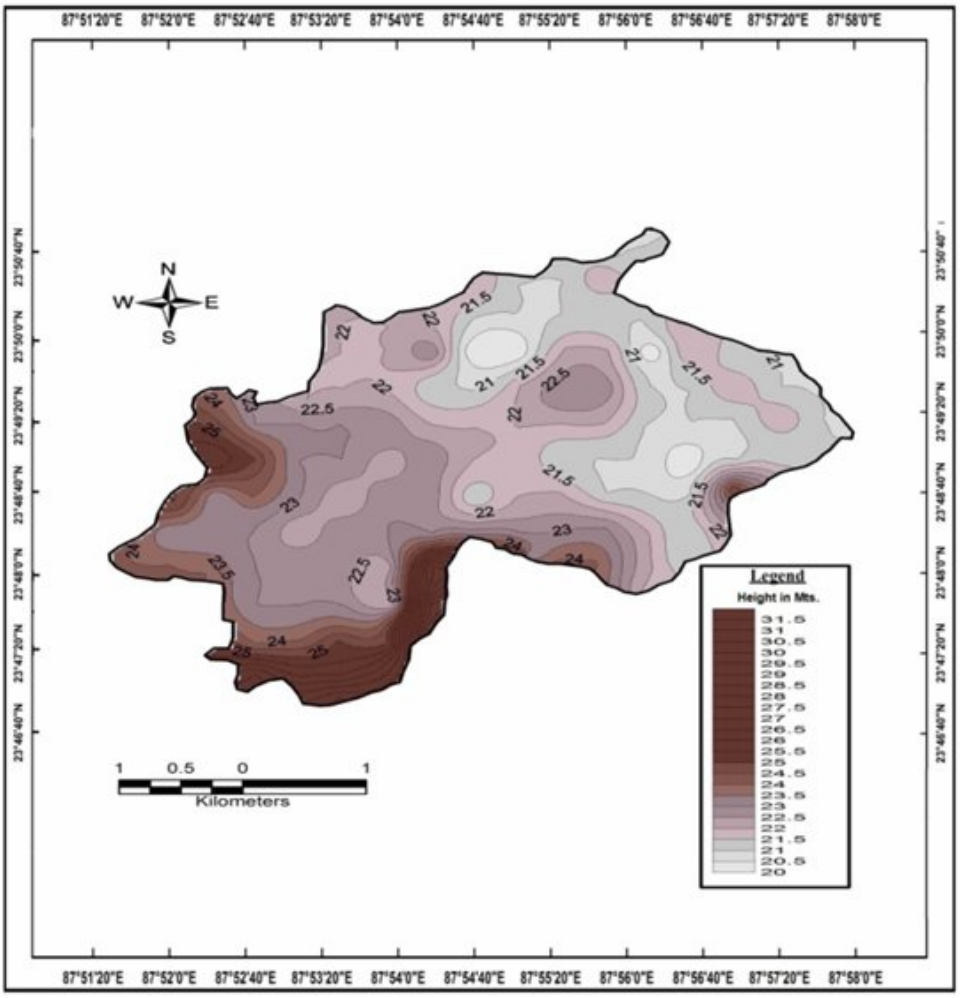

Fig. 2 Contour map of Langolhata Beel
(Source: Field survey with the aid of GPS)

4. Result and Discussion

4.1 Hydrological Characteristics of the Langolhata wetland

Surface and subsurface hydrological condition of flood plain wetlands imperatively determined by regional slope, sub-surface slope as per the presence of fracture, pheratic water divide, slope of the hydraulic heads, porosity and permeability of soil, nature of catchment area, pattern of rainfall, anthropogenic activities and so on (Pal,S.,2009). In this regard the flood plain seasonal Langolhata wetland has some dominant hydrological characteristics:-

Water stagnation period is confined only during the time of Monsoon & few months of post-monsoon (June to Nov) (Fig.4).

Depth of water varies from western part towards the eastern part of Langolhata beel (Fig.3).

During the time of post monsoon waterlogging situation is confined to the deepest part of the wetland.

4.2 Factors controlling the hydrological condition of the Langolhata wetland

The earlier discussed hydrological characteristics of Langolhata wetland is controlled by various hydrological parameters like rainfall, river water fluctuation, sinuosity of the river & channel cross section.

4.3 Rainfall

Lion part of the rainfall occurred during the time of monsoon, therefore this wetland receives maximum water during this time. Monsoonal rainfall pattern

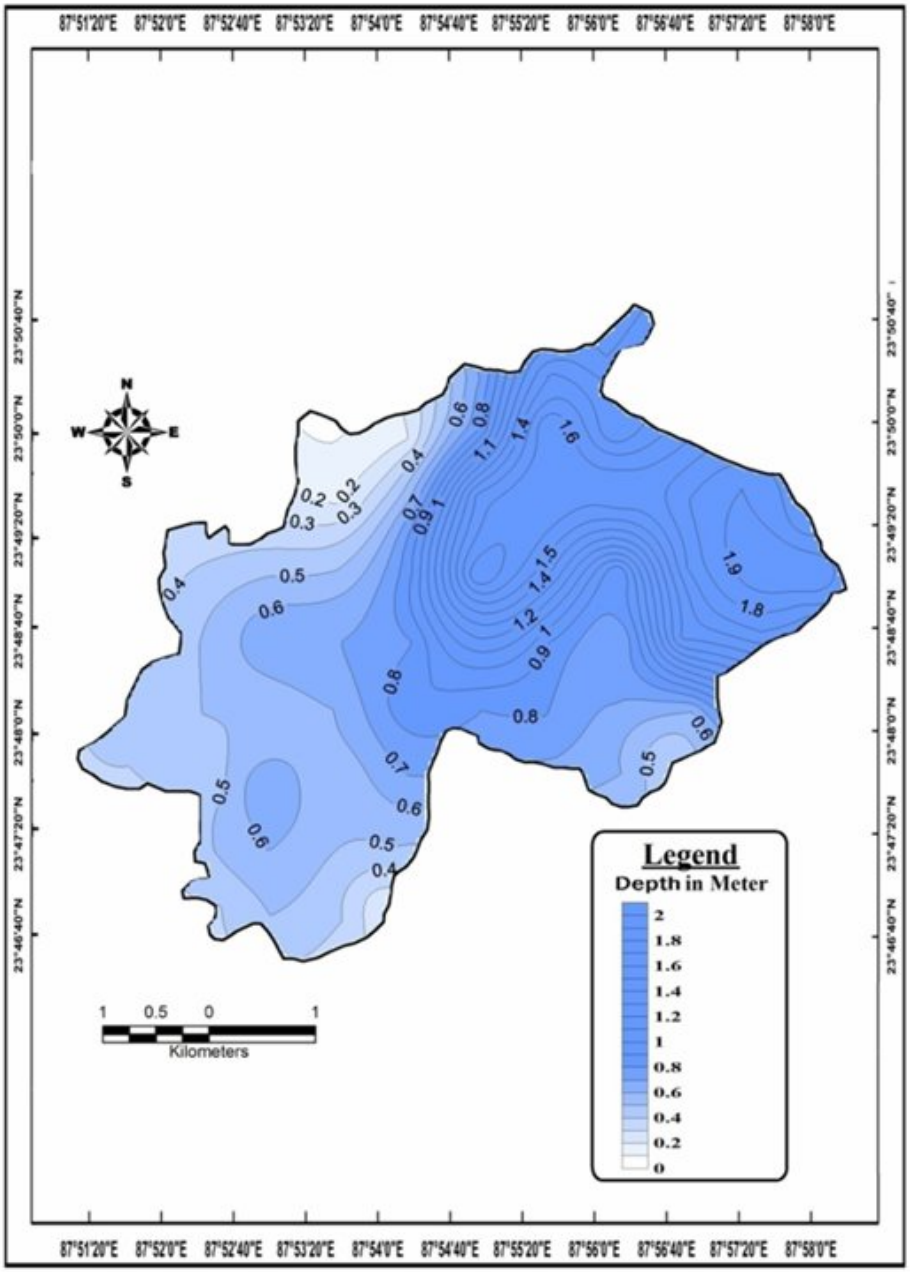

Fig. 3 Iso-water depth of Langolhata Beel during Monsoon period

very recently have altered to some extent. Total amount of rainfall during monsoon months have been changed notably (In 1980, avg. monsoonal rainfall was 259.13 mm but in 2013 the avg. monsoon was 214.7 mm) as well as the irregular rainfall pattern has noticed due to arrhythmic short ranged outburst interleaved by long range rainless days. In 2013, during the month of July-August wetland receive maximum average rainfall i.e. 217.62 mm within average 11 days recorded by Agricultural Development Office of Labpur. With this outburst of rainfall the water of the wetland as well as amount of flow of water of Kuya

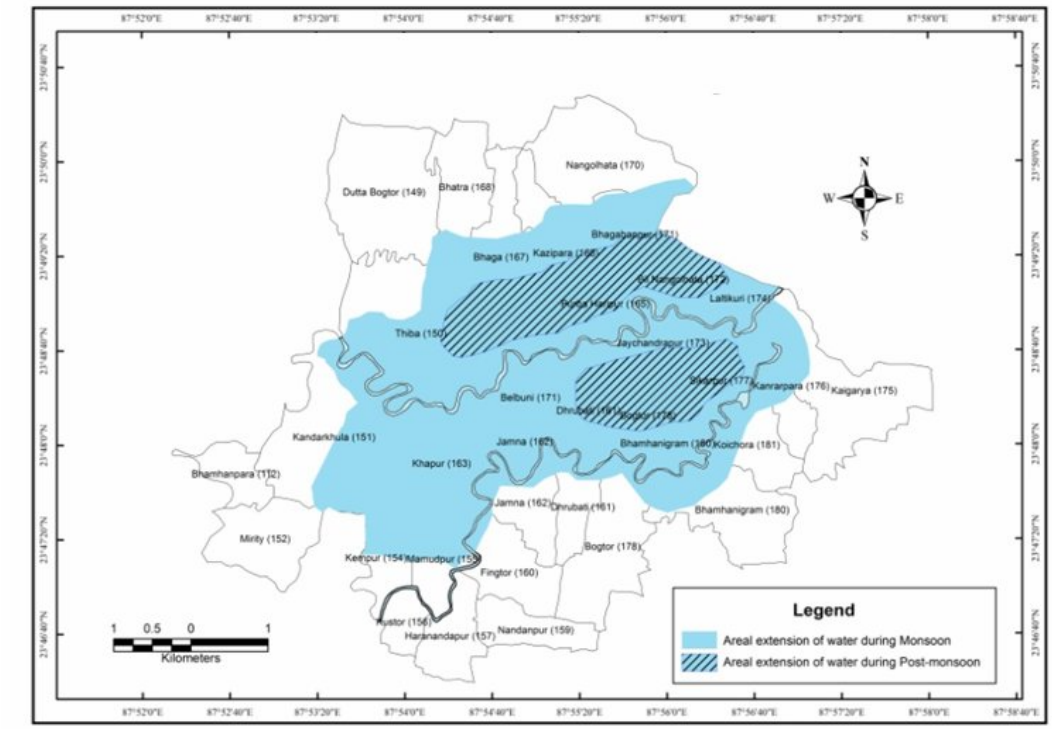

Fig. 4 Areal extension of wetland at Langolhata Beel

river & nearby Kandar khal has increased & overtop the banks and this excess water causes flood to the wetland. But with the leaving of S.W. monsoon, the wetland's water becomes contract and some deepest parts of the wetland hold water.

4.4 Fluctuation of river water

River water fluctuation is another important hydrologic parameter to control wetland surface hydrology. Fluctuation of the river water is attached with the amount of rainfall. As the rainfall increase the river water going to be increased. During the time of monsoon the water holding capacity of both Kuya River and Kandar khal become lowered down, it create numbers of overflow point through the river water entre into the wetland. Correlation has done between rainfall, river water regime & wetland water regime & result has been shown in the following table. The result has shown that all the parameters are high positively correlated.

4.5 Channel cross section & Sinousity of the rivers

Four channel cross-sections have been done in the upper and lower portion of the wetland in both Kuya River and Kandar khal. By this cross section it has been seen that in Kuya river upper cross sectional part (near Kanderkula) is more wide i.e. 36 Mts. than lower part (near Haripur) i.e. 25.5 Mts.(Fig.5). It is notable that though the depth of river near Haripur is

Table 1: Coefficient of correlation among different hydrological parameters

Variables	Rainfall (mm)	River water fluctuation(mm)	Wetland water fluctuation(mm)
Rainfall (mm)	1.000	.431	.934
River water fluctuation(mm)	.431	1.000	.694
Wetland water fluctuation(mm)	.934	.694	1.000

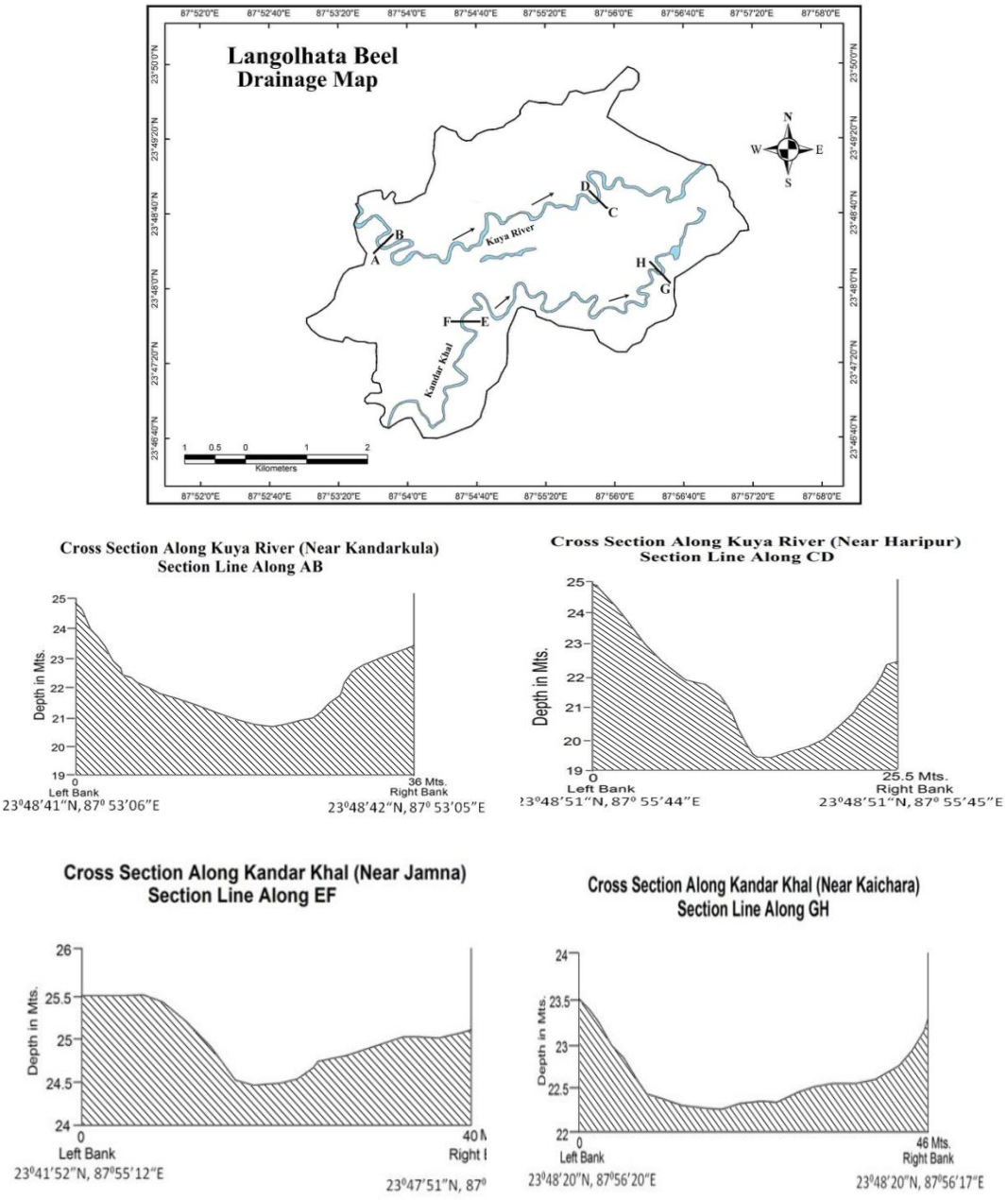

Fig. 5 Cross section of the study site

about 3.975 Mts. But its narrow width causes overflow towards the wetland. On the other hand cross sections on Kandar Khal (Fig.5) show that the width is wide but the depth is low which the result of overflow of water is during Monsoon.

In this region sinuosity of the rivers which may be considered as one of the most dominant determining factor to controll the hydrology of the wetland. Both the Kuya River and Kandar Khal indicate SI value 1.5 that means both the channel is meander channel (Fig5). For these meandering characteristics the water holding capacity is low which ultimately causes overflow of water towards the wetland.

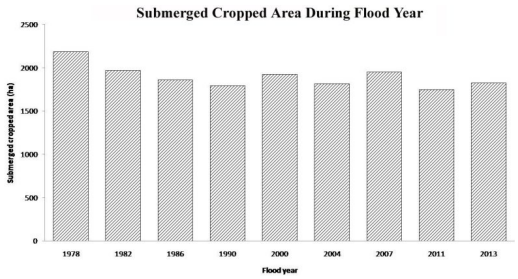

Fig. 6 Submerged cropped area during flood

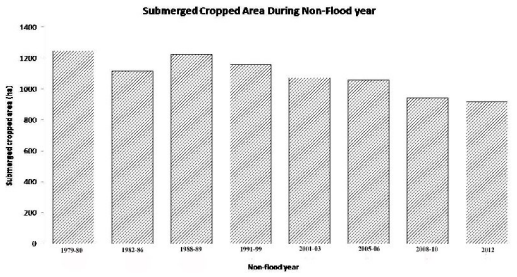

Fig. 7 Submerged cropped area during non-flood

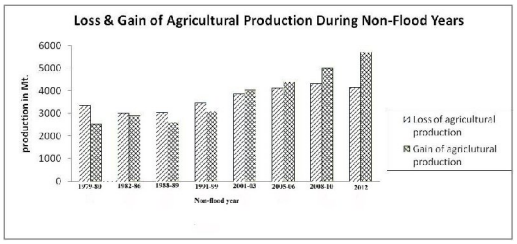

Fig. 8 Loss & gain of agricultural production during non-flood area

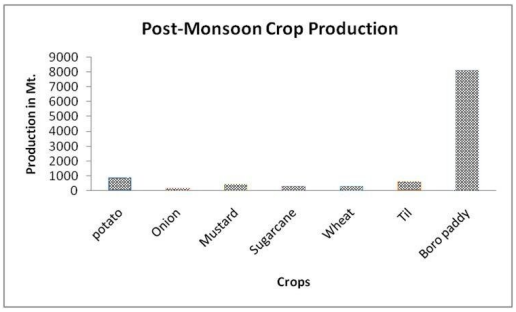

Fig. 9 Post-monsoon crop production

4.6 Impact of Seasonal regime of Langolhata wetland on Agriculture

Agricultural activities of both monsoon and post-monsoon are strongly determined by seasonal hydrological fluctuation of wetland. The main agricultural crops of this wetland are Aman paddy, Boro paddy, wheat, mustard, onion, potato, sugarcane and til. The agricultural pattern of wetland has separately studied for the monsoonal and post-monsoonal seasons.

4.6.1 Monsoonal agricultural

In monsoonal season typical characteristics of agriculture have noticed in flood year and non-flood year.

4.6.2 Flood year agriculture

Flood year means the height of the rise of wetland water above danger level. Before onset of monsoon the villagers sowing the amon crop but due to flood crops are being submerged. A temporal study has done to show changing submergence cropped. The average submergence during flood year is about 1895.93 ha. Fig.8 shows that the submergence areas of crop become decline 1978 to 2013 from 2185.14 ha to 1825.03 ha. These declining trends indicate the irregularities and decline of monsoon rainfall. During the flood year villagers lost almost 90% sowing crops, they get only 10% cultivated crops.

4.7 Non-flood year agriculture

Non-flood year means reasonable water level of wetland during the time of monsoon. Temporal study of these years (Fig.7) reveals the fact that on an average 1090.15 ha area is submerged, so some crops can be grown in waterlogged free zone. Therefore, villagers gain some crops during non-flood year. Fig.8 reveals the loss and gain of agricultural production during non-flood year. During 1979-80 loss and gain of crop production both are high it is about 3362.91 Mt. and 2536.94 Mt, but in 2012 the loss is about 4129.92 Mt. and gain of crops is about 5703.21 Mt. The major causes of this kind of changing pattern is after 1990 villagers was introduced by HYV seed (e.g. IR 36) and also they used huge amount of chemical fertilizer. As a result total production is very much high vis-à-vis both loss and gain of agricultural production are also reasonably high.

4.8 Post-Monsoon agriculture

Post-monsoon agriculture has practiced with the aid of stagnant water of the wetland and river water; though now a day deep tube well are used for irrigation. In this wetland the main post-monsoon crops are Boro paddy, potato, mustard, wheat, sugarcane, onion and til. About 80% of the cropped area is used to cultivate boro paddy and rest of the part is used for other crops cultivation (Fig.9).

5. Conclusion and Suggested Strategies for Sustainable agriculture

As complete dependency on crops production is being submerged each and every year, so some strategies can be suggested for the sustainability of the wetland.

i) Hogol is the main raw material for making mat. So, extension of indigenous Hogol cultivation of this wetland helps to form small scale mat making cottage industries.
ii) Some hydrophytes plants like Lotus may be cultivated during the monsoon in deepest part of the wetland, which has also great demand locally.
iii) Cultivation of jute can be introduced in this swampy area.
iv) Introduction of fishing act as occupation by desiltation of some part wetland.

So in last it can be conclude that wetland is a dying natural resource therefore to create balance between agriculture and hydrological status in Langolhata wetland the sustainable agricultural developmental programmes should be implemented by considering its seasonal hydrological fluctuation.

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