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CAUSES AND CONSEQUENCES OF CHANGING LANDUSE & LANDCOVER PATTERN: A CASE STUDY OF LALGOLA BLOCK, DISTRICT OF MURSHIDABAD, WEST BENGAL

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ABSTRACT:

Globally Landuse and Landcover are gaining its importance and to hone its understanding, need global attention and research. To predict global landuse and Landcover changes it will be prudent to use numerical models and Landsat imageries. Considering socioeconomic conditions to be one of the major driving forces in changing pattern, it is imperative to give more value to understand the causes of their disparity. Some of the other reasons considered are extensions of socioeconomic conditions which are inordinate population growth, climate, river meandering and erosion, deforestation, environment, floods and flood damage All these have a role to play to change the Landuse and Landcover pattern change. In the present context, the study area Lalgola had undergone a series of upheavals in the past half a century, the major one being the Unprecedented of population growth which changed primary occupation of agriculture to secondary or tertiary sector consequently changes in landuse pattern. The other important change is that impact of severe flood and deforestation made it even worse, changing the landform. All together gave a synergistic effect in changing Landcover and Landuse in Lalgola Area.

KEYWORDS: Population growth, climate, deforestation, flood, biodiversity, urbanization, Green House Gases (GHG), net sown area (NSA).

INTRODUCTION

The area chosen for the Study Lalgola CD Block, Murshidabad district of West Bengal, is sandwiched between two major rivers of the district, Bhagirathi in the west and Ganga/Padma in the east. Lalgola shares international border in the east and continuous infiltration is on for decades, the population increase recorded unprecedented growth leading to density of population to 2500/Sq.Km in 2011 and by Aadhaar estimate 2021, it is over 3100/ Sq.Km. Such a despairing situation leads to abject misery and socioeconomic conditions to its lowest ebb. To meet the increased productivity for such a large population, change in landuse is evident. Natural calamities such as flood, drought deforestation, climatic change, each one of them contribute to the changes in Landuse Landcover pattern. Lalgola, the study area is archetypal of the above and under constant threat and many of them are in degraded condition that can bring a vital environmental, social and economic problem.

OBJECTIVES: To understand the causes of Land Use and Land Cover pattern changes in Lalgola Block, District of Murshidabad, need to analyze the attributes which may have contributed to the changes and consequences are felt in the form of inundation, ground water depletion, Landcover degradation,

structural characteristics, climate change and ecological deterioration. It is important to understand these attributes to invoke strategies to improve the Landuse Landcover condition.

LOCATION: The study area, Lalgola Block of Murshidabad district, is situated on the bank of the Ganges which separates India and Bangladesh and situated $24^{\circ} 42' N$ longitude and $88^{\circ} 25' E$. latitude, covering an area of 134 sq. km. The average elevation of Lalgola Block is about 23 meters from MSL. Geographically Murshidabad district is located between $23^{\circ}43'30''$ and $24^{\circ}50'20''$ North latitude and $87^{\circ}49'17''$ and $88^{\circ}46'$ East longitude, with an area of 5,324 Sq.Km. It is one of the most densely populated districts of the state.

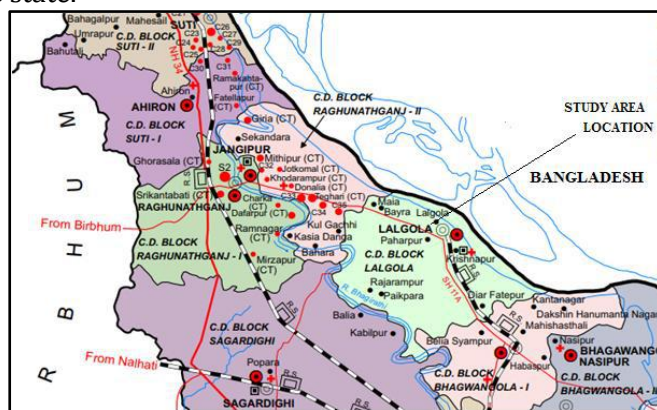


Fig No 1: Location Map of the study area Lalgola Block, Murshidabad district, West Bengal.

PHYSIOGRAPHY: The intermediate tract situated in the Indian Territory that lies between Bhagirathi and Padma rivers and the location from which the great deltaic plain originated can be called Murshidabad. The district is divided into two broad zones namely Radh and Bagri, which are situated on the Western and Eastern side of the river Bhagirathi respectively. The Western tract or Radh is primarily a continuation of the sub-Vindhayan region composed of laterite clay. The Eastern tract or Bagri lies almost entirely between the Ganga-Bhagirathi basins and is characterized by the existence of inundation along with many swamps. The soil of Bagri area is mainly of alluvial type and is characterized by comparatively light texture, low organic carbon content and the soil reaction ranging between slightly acidic to neutral.

DATABASE:

Both Primary and Secondary data have been used in this paper. Primary data has been generated using questionnaire survey, interview, field visit and the secondary data collected from various sources such as Census Book of India 2011, 2001&1991, Irrigation Department, Survey of India, District Statistical Hand Book and Annual Reports. Some photographs have been used wherever found necessary and were collected during field visits by the author.

METHODOLOGY:

Methodology adopted:

1. The study made use of various secondary data mainly vector data used for land cover and land use changes.
2. Data acquisition – this step has been divided into 2 parts- first, vector file format of the study area has been downloaded, secondly LANDSAT Satellite Imageries.
3. To study demographic changes, census reports of 1981, 1991, 2001, 2011 published by Govt. of India are used.
4. Changes in agricultural patterns are studied on the basis of reports published in the District Statistical Handbook, Murshidabad-1990 to 2011 published by the Bureau of Applied Economics and Statistics, Govt. of West Bengal.

5. Interactive session with local people related to agriculture through questionnaire for perception study.

DISCUSSION : The causes of Land Use and Land Cover pattern changes in Lalgola Block, the District of Murshidabad, are considered, and need to analyze the attributes which may have led to such changes. They are 1.High Population growth and Pressure on Landuse 2.Climate and natural calamities 3.River bank shifting/Meandering and river bank erosion 4.Deforestation 5.Biodiversity changes 6.Urbanisation 7. Migration 8. Environment.

1. POPULATION GROWTH AND IMPACT ON LANDUSE AND LANDCOVER:

The rate of population growth plays a vital role in changing the Landcover and Landuse pattern in Lalgola Block, of Murshidabad district.

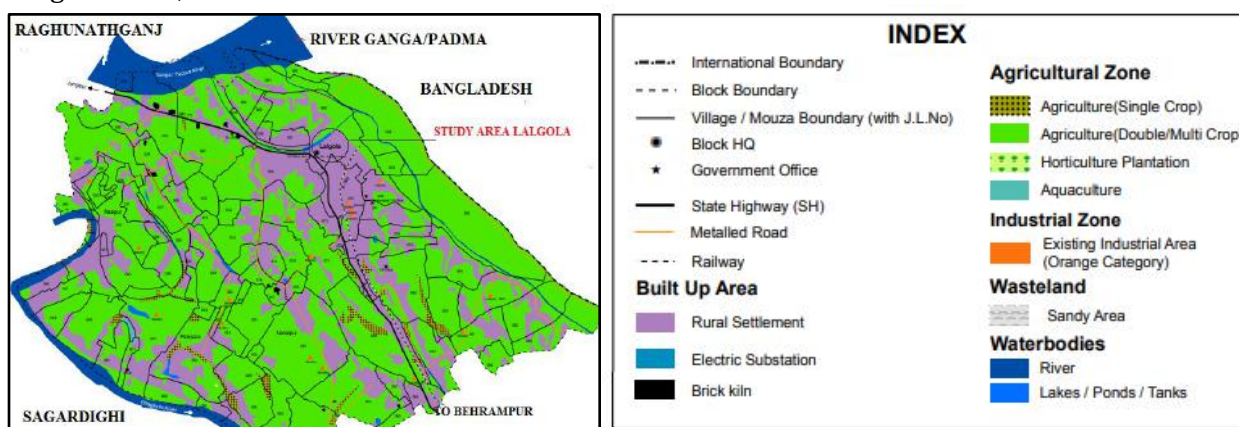


Fig No: 2 land use / land cover map Lalgola block, Murshidabad district, west Bengal.

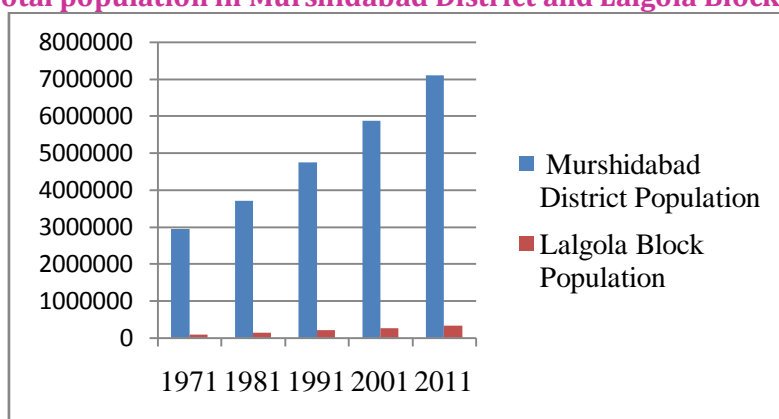
Source: Spot-heights from Survey of India. Other elevations are from Shuttle Radar Topography Mission data of 2000.

The Landuse and Landcover map (Fig. No 2) is used for understanding the impact of different sets of parameters as in the index. Lalgola is bounded by the international border and River Ganga in the east and Bhagirathi River in the west. The Landuse/ Landcover map of Lalgola Block clearly defines and endorses the occupation functionality of the area as agriculture. The traditional occupation, agriculture, which is clear from the map, covers 52.72% of the area and settlements covers the remaining 24.89% except a few smaller areas of landuse. There are few sporadic occurrences of water bodies and industry including brick kilns. . The following table (Table -1) shows the pattern of population growth in Murshidabad District and Lalgola Block from 1971 onwards.

Census year	Population Murshidabad District	% change in Murshidabad	Population Lalgola Block	% change in Lalgola Block
1971	2940204	-	80968	-
1981	3697552	25.76	140178	73.13
1991	4740149	61.22	201565	148.94
2001	5866569	99.53	267641	230.55
2011	7103807	141.61	335831	314.77

Source: Census of India , 2011.

Table No 1 Total population in Murshidabad District and Lalgola Block (1971-2011).



Source: Census of India 2011.

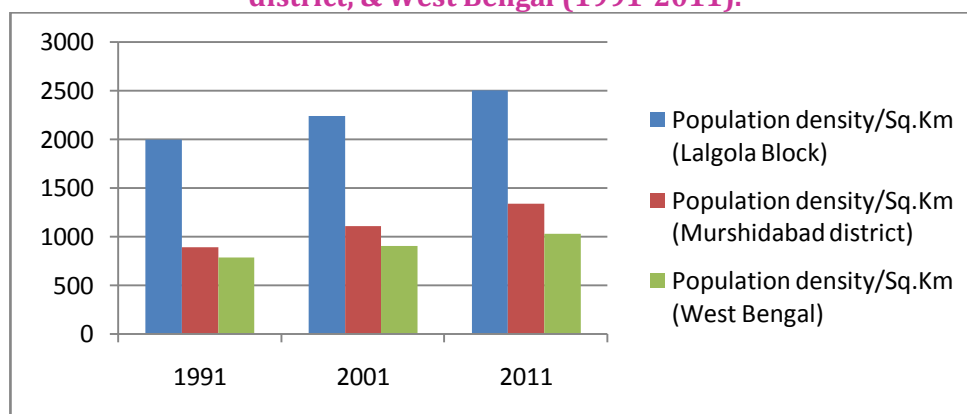
Figure No: 3 Total populations in Murshidabad District and Lalgola Block (1971-2011).

From Table No 1 & Fig No 3, it is observed that over a period of 40 years, increase in population growth in Murshidabad district is almost 141% whereas in the same period Lalgola as a CD Block, the geographical area remaining the same, the population growth is staggering, over 314%, the density of population of Lalgola has increased exponentially. The impact of this rapid population growth and density of population in Lalgola Block has resulted adversely in the Land use and Land cover changes.

Year	Population density/Sq.Km (Lalgola Block)	Population density/Sq.Km (Murshidabad district)	Population density/Sq.Km (West Bengal)
1991	1994	890	784
2001	2234	1102	903
2011	2500	1334	1029

Source: Census of India (various years).

TABLE NO 2: Comparison of density of Population of the study area (Lalgola), Murshidabad district, & West Bengal (1991-2011).



Source: Census of India 2011 .

Figure No: 4 Density of Population of the Lalgola Block, Murshidabad District and West Bengal (1991-2011). Other important criteria driven by Population growth is groundwater depletion. This depletion generates water stress conditions and promotes unsustainable resources and may induce changes in landuse pattern change.

The population growth in the study area has resulted in the change in the occupational pattern to suit their sustenance if not subsistence. Urbanization endangers agriculture and offers land available for it. The rural population in search of new opportunities, lucrative offers and better life, migrate to urban areas. The decreasing trend of land availability due to land fragmentation, urbanization and agricultural workers migration results in loss of productivity. To compensate for productivity against the increasing population growth, land use pattern changes.

The relationship between population growth and the landuse dynamics has not been easy to understand and comparing them is all the more difficult as the general framework within which it is to be compared contains different variables such as geographical location, ecosystem or landscape. Till date the agricultural production has met most of the growing demands of the populations in the developed countries, it remains to be seen how far the technology can stretch to meet the demand for developing countries without obliterating the ecology and environment. This shows that with all technological improvements not all could be achieved as there are equally important factors responsible for producing food for such a large population such as climate, landuse, soil fertility & topography etc. With such a large population in Lalgola to cater, there is threat looming over changing pattern from primary to secondary or tertiary segment due to longer gestation period in crop grown, instead quick money in secondary or tertiary sector. Any such change is exacerbating the challenges faced by the agriculture sector. Fragmentation of land, depletion of water table, non availability of credit facilities, and inadaptability of technological improvements, all added up creating a situation of despair.

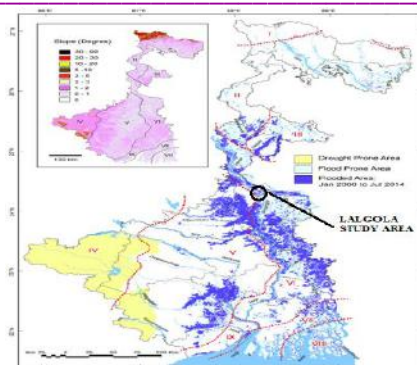
2. Climate and impact on land use & land cover: In the study area Lalgola Block where agriculture is the main stay, remains affected by climatic conditions. The climate of the district is a tropical wet-and-dry climate (Koppen climate Classification -A). The winter season is from December to February. Summer season Norwester occasionally occurs during March-April. The rainy season generally starts with the South-west monsoon – June to September. The Agricultural landuse pattern generally depends on the rainfall pattern and reduces the soil cohesion and increases the pore pressure. It also affects the slope stability depending on the duration and intensity of rainfall. There is an intricate relationship between climate and Landuse and Landcover. The land cover as manifested by landuse practices affects the global concentration of greenhouse gases (GHG). The changing climate changes landuse and Landcover. For a higher return on investment, may change and adopt different agricultural practices under changing climatic conditions. Higher temperatures affect vegetation cover and low temperature may affect the crop yield and adopt different crop based irrigation on changed Landcover and agricultural practices.

Temperature: In the Lalgola study area annual mean temperature is approximately 27°C monthly mean temperature varies between 17°C to 35°C. May is the hottest month in summer with daily average temperatures ranging from a low of 27°C to a maximum of 40°C. December and January are the months in winter, January generally is the coldest month with minimum temperature between 9°C to 11°C. In Lalgola, during peak summer, scarcity of water forces farmers to withdraw more water from the underground using deep water tubewells resulting in depletion of underground water table .

Flood and its impact on landuse & landcover:

The main causes of flood in this Block can be listed as follows:

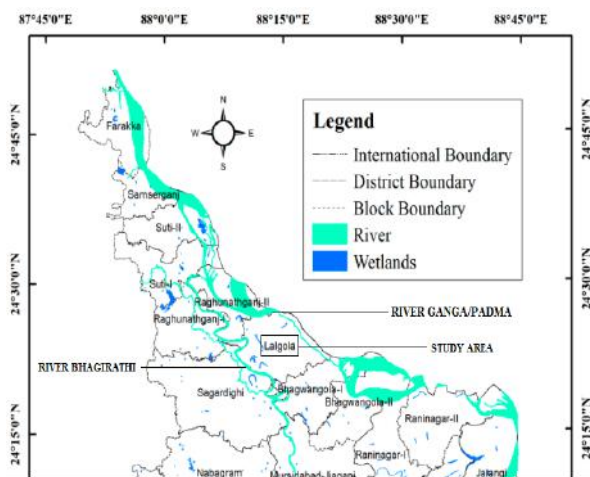
- (i) Incessant and unprecedented rainfall
- (ii) Overflowing of the rivers Ganga, Padma, Bhagirathi, Mayurakshi, Brahmani, Jalangi and their tributaries due to heavy rainfall
- (iii) Sudden discharge of excess water from the nearby dams
- (iv) Erosion of riverbanks



Source: Extent of flood prone areas from DoIW-GoWB, 2014; Actual flooded areas from DFO, 2014; Drought-prone areas from WBPCB, 2009; Slope map derived from Shuttle Radar Topography Mission data of 2000.

Figure No. 5 showing areas susceptible to flood and drought in lower Gangetic plains, West Bengal. Zones I-IX indicates physiographic divisions.

The Fig No 5. regarding the three main features projected is 1. The extent of flood prone areas which may be subjected to flood 2 The actual flood hit areas and lastly 3.The drought prone areas which remain dry during various period of time.



Source: Assessment of Wetland Ecosystem Health Using the Pressure–State–Response (PSR) Model: A Case Study of Murshidabad District of West Bengal (India) Subhasis Das1 et al .

Figure No: 6 Vulnerability of Lalgola study area against flood, being sandwiched between River Bhagirathi and River Ganga/Padma.

The economic losses from flood are generally attributed to surface topography, existing Landcover and Landuse pattern, and the type of environment prevailing, built up area and consequent impervious area. The intensity of flood will also depend on the rate of change in urbanization and the magnitude of the rainfall. The other factor which comes into play is the nearby dams or embankments damage. During heavy monsoon, the gates of the dam/s are opened to save the dam without paying any heed to losses or severity of damage of life or property, it may cause to the people downstream. The intensity and the damage of the flood will also depend on the location, population and density of population and socioeconomic condition of the people in consideration.

Figure No: 6 clearly show the study area Lalgola is sandwiched between two major rivers, Ganga/Padma in the east and Bhagirathi in the west. During monsoon, excess water from the catchment area exacerbates the flood situation and worsens and creates a miserable situation for the area. The change in the land use pattern in the area due to climate change leaves its footmark.

In Lalgola since long been affected by floods of high severity classified type. In 1994 Lalgola and Jalangi areas were flooded due to the breaking down of the embankment of the River Padma. In 2000, massive flooding occurred in Lalgola mainly due to over flow of water from the major rivers Bhagirathi and Ganga/Padma flowing through the district. Sudden discharge of water from the dams, causing serious damage to settlements, loss of property and life apart from erosion and Riverine damage.

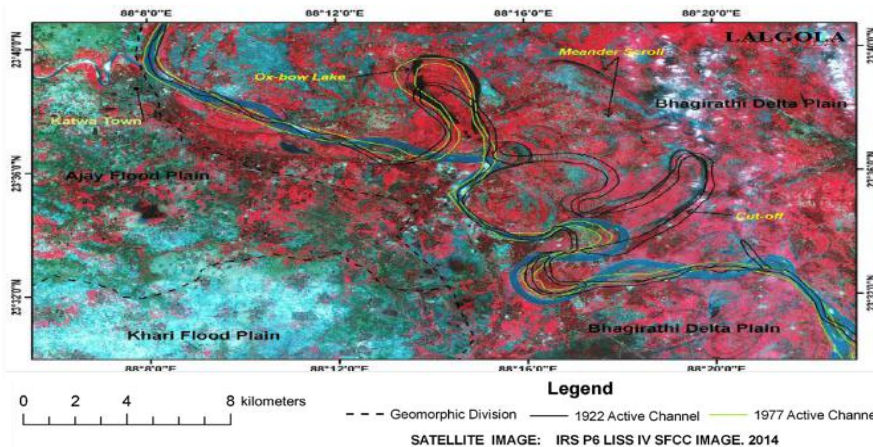
3. Riverbank Shifting/Meandering and river bank erosion and impact on land-use & Land-cover:

It is observed that the shifting or meandering of the Bhagirathi River has a great impact on the Landuse & Landcover pattern changes. The Riverine land along the river could not be developed or used for any agricultural or settlement. The rivers of Lalgola are incising the banks in the meandering edges. The uncertainty of the catastrophic nature of flood unnerves the people living in the Riverine areas of Lalgola.



Figure No 7: River bank erosion and mass failure in Lalgola Block, Murshidabad.

Riverbank erosion is due to two main reasons, one is due to bank scour, and other due to mass failure. The contributing factors to river erosion are flooding, landuse and stress management, river straightening, and rapid flow drop after flooding, intense rainfall, and bank soil characteristics. It is observed that the shifting or meandering of the Bhagirathi River has a great impact on the Landuse Landcover changes. The Riverine land along the river could not be developed for any agricultural or settlement. The rivers in Lalgola are incising the banks in the meandering edges. The uncertainty of the catastrophic nature of flood, unnerved the people living in the Riverine areas of Lalgola. This information on Landcover and Landuse are extremely important for any future planning and welfare of the people of the area.



Source: Sanat K. Guchhait, Physical Geography 2016.

Fig No: 8 Spatio-temporal change and oscillation of the Bhagirathi River between 1922 and 2014.

The meandering of the river is causing unprecedented erosion resulting in change of Land use and Land cover in Lalgola Block. River course breaks its natural path wherever it is met with least obstruction and the velocity and erosion are greatest in the concave side of the meandering of the river and deposition in the convex side of the meandering feature, visible in Bhagirathi River can be observed. It is observed from satellite image meandering course of River Bhagirathi and formation of Ox Bow Lake is seen between Murshidabad and Berhampore, the shifting of this river course deeply hamper the

landuse and Land Cover pattern changes in the Riverine belt of Lalgola. The riverbank shifting, meandering and river bank erosion all adding to the causes of Landcover and Landuse changes in their own way as has been detailed.

4. Deforestation and its impact on land-use & land cover:

Deforestation is the decrease of forest land for non forest use and worldwide deforestation rate per decade is about 1.3 million Sq.Km according to FAO. The land use change driven emissions in large areas of forestation causes carbon deficit. Deforestation causes climate change, desertification, soil erosion, fewer crops, flooding, increased greenhouse gases in the atmosphere, all adding to the causes of Landcover and landuse changes. To address the economic sustenance in regards to wood sustainability in the local or export demands drive landuse changes. Non availability of alternative sources of sustenance drives deforestation and degradation and causes changes in Landcover and landuse pattern change. On the same pretext, the persistent and indiscriminate deforestation happened in Lalgola Block for decades due to human activities, affected the rugged landscape caused soil erosion and carbon sequestration.



Source: Field survey by the author.

Figure No 9 : Deforestation in Lalgola Block, Murshidabad, West Bengal.

5. Biodiversity and Environmental Impact:

Biodiversity refers to one system more specifically to refer to all of the species in one region or ecosystem. Biodiversity includes all living things, including plants, bacteria, animals, and humans. Agricultural biodiversity is important in anthropogenic life cycle as it provides most importantly food, biofuels, shelter etc.

Agricultural biodiversity has important functions to play in the ecosystem such as conservation of soil fertility and water, biota and plant pollination, all of which are essential for food production and for human survival. Essentially all are leading causes of landuse and Landcover change. In the Lalgola study area, modern agricultural practices, which include intensive inputs of nitrogen and phosphorus fertilizers and the concentration of livestock and their manures within small areas, have substantially increased the pollution of surface water by runoff and erosion and the pollution of groundwater by leaching of excess nitrogen (as nitrate). Other agricultural chemicals, including herbicides, pesticides are also used and surface water for agriculture leeches in some cases, remains as contaminants in the soil, gradually changing the soil chemistry and becoming one of the causes of change in landuse and Landcover pattern.

6. Urbanization and its impact on land use & land cover:

Urbanization has been one of the main attractions for the rural population. The built up area is reduced and increase in concrete area leads to environmental degradation. Following urbanization trends, effects on Land Use and Land Cover can be deciphered. It is associated with rapid population growth, pressure on land etc. The decadal growth rate of urban population from 1901 to 2011 in Murshidabad district is almost 1300% and the manifestation of this has left footmark in the form of changes in the Landcover and Landuse.

CONCLUSION :

For understanding the causes and consequences of Landcover-Landuse changes, Lalgola Block of Murshidabad district has been chosen as the study area. The attributes which may have caused changes are enumerated here.

Population growth has been the most prominent. The decadal population growth rate for Murshidabad has been over 141 % in 40 years span from 1971 and during the same period Lalgola registered over 314%, the geographical area remaining the same, the density of population increased to an astronomical figure of 2500 /Sq.Km whereas, at the same time, the state had 1029 /Sq.Km. To accommodate such a huge population was an uphill task for Lalgola, let alone their sustenance. The agricultural practices being followed could not sustain the food sustainability due to obvious reasons and were adopting multi crop production increasing the net sown area value. The decreasing trend of land availability due to land fragmentation, urbanization and agricultural workers migration results in loss of productivity. To compensate for productivity against the increasing population growth, land use patterns change.

Climate has always been an integral part of the landuse and Landcover pattern change. The land cover as manifested by landuse practices affects the global concentration of greenhouse gases. For sustenance may change and adopt different agricultural practices under changing climatic conditions. Higher temperatures affect vegetation cover and low temperature may affect the crop yield and adopt different crop based irrigation on changed Landcover and agricultural practices. Lalgola continues to remain heavily waterlogged for three to four months of the year and jute and paddy are the main crops grown. However alternative crops are also grown like pulses, mustard etc in suitable areas changing the pattern of landuse.

The river bank shifting meandering and erosion can be seen extensively all along both the rivers flanks of Bhagirathi in the east and Ganga/Padma in the east. The meandering leaves an opportunity to form Ox Bow Lake. The spatio temporal shifting of Ganges River is gradually losing its centre line and land from southwest to northeast direction. This kind of shifting leaves space for the land to form and erodes the other end resulting in land use change. Deforestation causes climate change, soil erosion, flooding and increased Green Houses Gas etc. Non availability of alternative sources of sustenance drives deforestation and degradation and causes changes in Landcover and land use pattern change. Indiscriminate deforestation due to conversion of forest for other Land use purposes, illegal and unsustainable logging, fuel wood harvesting, mining leading to degradation of soil and Land cover Agriculture biodiversity encompasses all components of biodiversity, which has a direct relationship with food and agriculture. Constant change in the agricultural pattern induces change in the bio world as in order to increase productivity, fertilizers of different composition and grade are used which when leached or during runoff changes the soil composition and natural equilibrium of the ecosystem.

Urbanization means the gradual increase in the proportion of people living in urban areas leaving agriculture-oriented livelihood. Following urbanization trends, effects on Land Use and Land Cover can be deciphered. It is associated with rapid population growth, pressure on land etc. The decadal growth rate of urban population from 1901 to 2011 in Murshidabad district is almost 1300% and the manifestation of this has left the footmark in the form of changes in the Landcover and Land Use. Various infrastructure projects and dams, barrage, and other industrial projects requiring huge built up area contribute to the Landcover and Land Use changes.

The causes and consequences of Landuse and Landcover of the Lalgola study area endorses the hypothesis and authenticate that population growth to be the most impacting factor and others like anthropogenic activities coupled with natural disaster like floods left a very ravaging effect on the population of the area. The local Block level and municipality with state level agencies are have formulating disaster management plan for flood relief and evacuation for the people who would be in distress which includes construction of shelter home, medical relief center for immediate action. Stringent action will be initiated against any offender for violation of forest legislation act.

The important conclusion of the whole exercise is that the Lalgola study area is no exception when considered for the causes and consequences of Landuse and Landcover pattern. The population

growth, climate, deforestation, environment impact, urbanization all have prolific impact on LULC. The exploitation of land as a resource is limited and needs to be used with diligence.

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