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ASSESSMENT AND MONITORING OF CHANGING LAND USE PATTERN BY USING RS & GIS IN THE STRETCH OF KANTHI COASTAL TRACT OF PURBA MEDINIPUR DISTRICT, WEST BENGAL.

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Abstract:
The present study aims to assess the pattern of Land Use / Land Cover Changes and to expound the impact of land use changes in the stretch of Kanthi coastal area of Purba Medinipur District of West Bengal. Human activities along with the natural coastal geomorphic processes are equally responsible for land use changes in the study area. People are becoming associated with more productive work to earn more, but they are not thinking about sustainable development. In Kanthi coastal tract of Purba Medinipur district, there are four blocks mainly Ramnagar-I, Ramnagar-II, Contai-I and Deshapran mainly involved with various agricultural activities and orchard farming. During the last two decades, the brackish water shrimp culture has rapidly increased in this study area. This practice has gradually destroyed the adjoining paddy fields. The soil becomes very much acidic for the same reason. The Land Use map of different years, namely, 2004, 2007, 2010, 2013, 2016, 2019, obtained from LISS-3 and LANDSAT images and digitized, using Arc GIS-10.1, ERDAS 9.1, and GLOBAL MAPPER 12 software. The principal land use was agriculture in the study area which has been rapidly converted fishing ponds and if the trend of changes continues then the area under study will face crisis of food crops and other socio-environmental problems. At present about 52.89 per cent of land is devoted to agricultural practices under agriculture and cropland has a major impact over the hydrological processes of the area. Therefore, the information obtained from change detection of LU/LC aids in providing optimal solutions for the selection, planning, implementation and monitoring of agriculture practices and other developmental processes to meet the increasing demands of human needs with proper and justified land management.

Keywords: Coastal geomorphic processes, sustainable development, orchard farming, brackish water shrimp culture, remote sensing and GIS, Land management.

Introduction:

Land is considered as one of the vital natural resources for the survival of human being and the base for all terrestrial ecosystem services. But land use changes has caused for severe problems at local,

national and global scale. Knowledge of land use and land cover is important for many planning and management activities and considered as essential element for modelling and understanding the earth as a system.

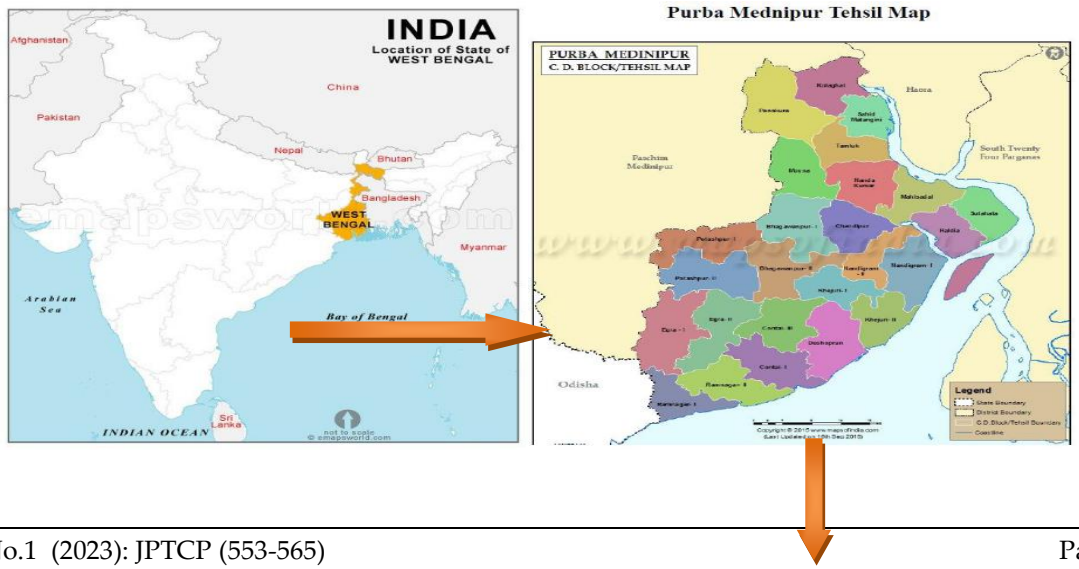
Land use studies and analysis has become a pre-requisite for proposing for developmental activities in an area. The growing demands on land have resulted in a crisis of land mismanagement. The present study includes preparation of land use maps during the last few decades, understanding the influences of human interventions in the coastal tract and formulating comprehensive and effective mitigation strategies for conservation of agricultural land in the study area using Remote Sensing and GIS.

As this study area locates along the Bay of Bengal, the area around the coast is saline in nature. Lots of creeks can be seen in this coastal area. Through these creeks, the saline water enters in to the inland and make salty. In addition, numerous small and large rivers flow over the region and have joined the Bay of Bengal. As a result, during the tide, the saline water of the Bay of Bengal enters the inland through the rivers. Salt marshes or wetlands can also be seen in various places along the coast.

In the past, the main livelihood of the people of this region was farming and fisheries harvesting. Except for the saline wetlands along the coastline, farming was the main livelihood process and earning process of the people. But currently, the population is growing rapidly. To meet the needs of these additional populations, various accommodations and construction are increasing like roads, homes, shops, markets, malls, etc. As a result, Agricultural land is gradually reduced. In the same way, people are making fisheries by simply converting cultivated land for having quick profitability. As a result, cultivated land is rapidly decreased and the quality of cultivated land is declining. As the quality of agricultural land is reduced, people are becoming more dependants on aqua farming without cultivation. As a result, fishery ponds have increased rapidly.

Location of the study area:

Purba Medinipur district was formed after the bifurcation of former Midnapore on and from 1st January 2002. Purba Medinipur district is the southern district of the Medinipur division (one of the five administrative divisions of West Bengal). This study area comprises four C D Blocks (Ramnagar-I, Ramnagar-II, Contai-I, and Deshapran) under the Contai Sub-division, locates along the coastline of the Bay of Bengal. The coastal stretch of this study area is about 40 kms long extending from Digha to Petuaghat. In this study area, familiar places to everyone are Digha, Sankarpur, Tajpur, Mandarmoni, Soula, Junput, Bankiput, and Petuaghat which are located along the coastline of the Bay of Bengal. Latitudinal extension of this coastal area is 21º 36′N to 21º 48′N and longitudinal extension is 87º 28′E to 87º 53′E. This study area is bounded by Orissa on the west; Egra- I & II, Contai-III, and Khejuri-I on the north; Rasalpur river on the east and the Bay of Bengal on the south.



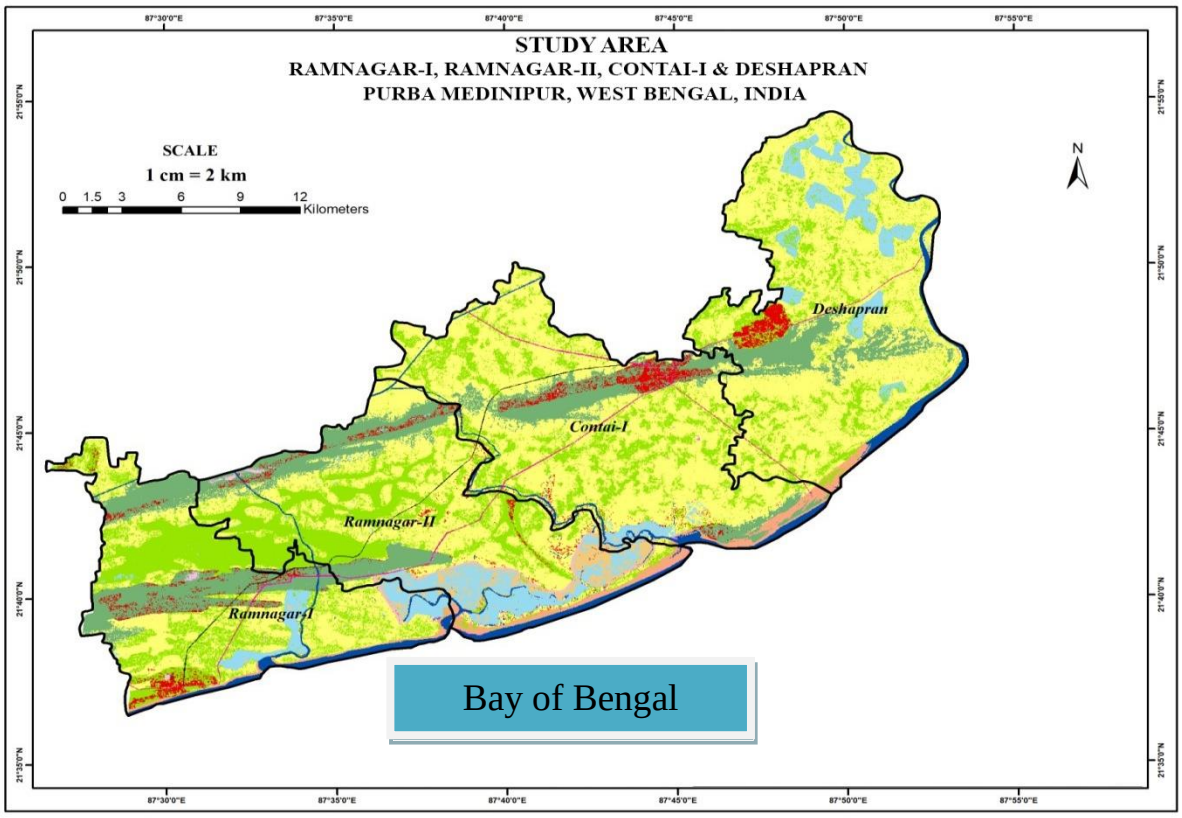


Fig: 1: Location of the study area.

Objectives of the study

The main objectives of the study are:

i) To analyse the nature and extent of Land Use/Land Cover Changes of the study area in the past 15 years (2004 – 2019).
ii) To identify the major components that promotes for trend in land uses (2004 – 2019).
iii) To find out the causes of decreasing agricultural land and increasing inland fisheries.
iv) To evaluate the causes and consequences of land use change.

Methodology

This study has been done based on an intensive visit to the study area for primary data, extensive literature review, field observation, experimental documentary analysis, different journals, different Govt. reports as secondary data, etc. All analysis will be supported by RS and GIS images of LANDSAT. The basic software is Arc GIS, ERDAS, Global Mapper, Geometica, etc. This study will be analyzed the trend of land Use Planning (LUP) and also the NBSS report on the soil. IMD reports should be taken to evaluate the changing trends of water bodies and soil.

Materials/Tools

The following materials are used for the analysis and evidence.

1. New cadastral map prepared by NRSC on Block and Panchayats label provided in Bhuban.
2. Vegetation Index satellite imagery [LISS-3, 1905]
3. LANDSAT images for DEM, vegetation, land use, communication, etc. from 2004, 2007, 2010, 2013, 2016, and 2019.
4. Satellite imagery analysis software - ARC GIS 10.1, ERDAS 9.1, GEOMATICA 12, GLOBAL MAPPER 12, PHOTOSHOP CC, etc.

Result analysis and discussion:

Changing land use pattern in the study area

Land is a primary resource of any human society and land use is the utilization of all developed and vacant surface land in a specific area and given time and space. It is a systemic arrangement of various classes of land based on certain similar characteristics mainly to identify and understand their fundamental utility. Land use methods are evaluated in many ways. Proper assessment is required to get the maximum output from the land. On that basis, land use is marked by various questions on the economic output. In the study area different land use pattern have developed.

Now the issues of need-based short term or long term land uses get priority. With the increase of population and flux of various services the concept of land use have been changed without considering the importance of other sectors. In reality it has been found the haphazard land uses developed like Locations suitable for the forest, used for government offices, dunes are destroyed for urbanization, railway line, road construction, and low lands are used for housing purposes. In the last 20 years, the rural lands mainly used for agriculture converted in to various types of shrimp and venami culture. This activity has been increasing day by day for more earnings and making quick profits. Moreover, to earn more export business has rapidly increased to meet the international market. For this reason the arable lands of this study area are being converted in to fish ponds. Agricultural productivity is being almost destroyed. If proper care and restrictions are not taken and control the business attitude the will immediately face food crisis. The uneven pattern of development of small towns like Kanthi, Shankarpur, Tajpur, Mandarmoni, etc. rapidly increasing and people are forced to change their agricultural land for urban uses without any basic principles.

For the perfect approach to the land use techno-economic survey to be introduced in terms of spatial coverage, a distinctive form of regional diagnostic survey. Recent technological advancements such as remote sensing should be introduced for water shade management. Thus the land use planning both in urban and rural sectors will be in order.

Table-1 : Volume Change in Land Use Pattern from 2004 to 2019

Sl. No.	Class Name	Area in Sq. km.					
		Area (2004)	Area (2007)	Area (2010)	Area (2013)	Area (2016)	Area (2019)
1	Fishery Pond	25.614	25.614	31.5882	34.1217	38.2599	40.599
2	Abandoned Fishery Pond	9.2664	9.2664	9.2664	9.2655	12.4668	9.2655
3	Fallow Land	0.2731	0.3717	0.4419	0.4068	0.7299	0.8109
4	Spoiled agricultural land	2.2455	2.2455	2.2455	2.2464	2.2455	2.2464
5	Forest	86.1831	85.1184	85.1301	86.5503	83.8683	85.7619
6	Orchards	145.1223	147.483	151.7679	156.1797	155.412	156.0969
7	Settlement	12.1761	12.3039	15.3594	15.2424	14.7303	16.2693
8	Water Body	25.6203	23.76	23.7933	21.8259	25.9848	21.9294
9	Road	3.0096	3.0096	3.0096	3.0195	3.0015	3.0195
10	Railway	1.1097	1.1097	1.1097	1.1232	1.1016	1.1232
11	Bare Land /Open Land	9.4473	10.9179	10.0395	10.0953	8.3187	11.8593
12	Backwash along Coast	0.5778	0.5778	0.5778	0.5868	0.6417	0.6489
13	Agriculture	327.1977	326.0619	313.4817	310.1481	299.8566	301.1814
14	Industrial Area	0.0342	0.0342	0.063	0.063	0.063	0.063

Source: LANDSAT8, Path & Row: 138/45 & 139/45, Calculated by the researchers

In table no.-1 it is found that the fishery pond and the settlement in this study area are increased but Agricultural land is decreased. Other land use provisions have mildly changed. In 2004 area under agricultural land was 327.19 Sq. Km where as fish pond area was only 21.64 Sq.km. But in 2019 the amount of agricultural land has decreased to 301.18 Sq.km and the area under fish pond has increased to 40.60 Sq.km. Settlement area has been increased by 4.5 % during the span of fifteen years. Water bodies have decreased by 4.13%, which is much alarming. Figures no-1,2, and 3 show the detail land use and land cover changes in the study area based on ground observations. These

supervised maps have been prepared using satellite imageries with the help of ARC GIS 10.1 and ERDAS 9.1.

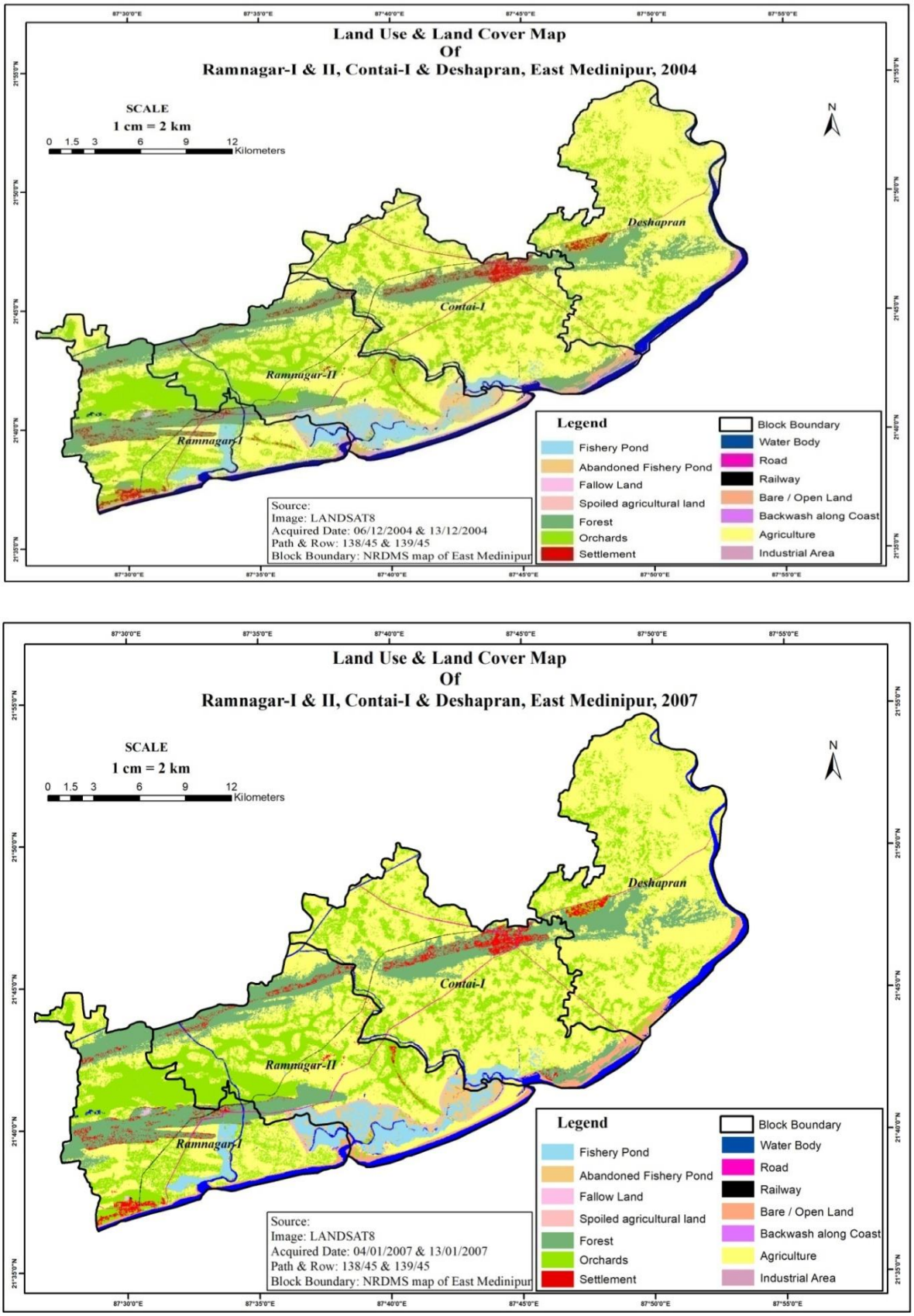
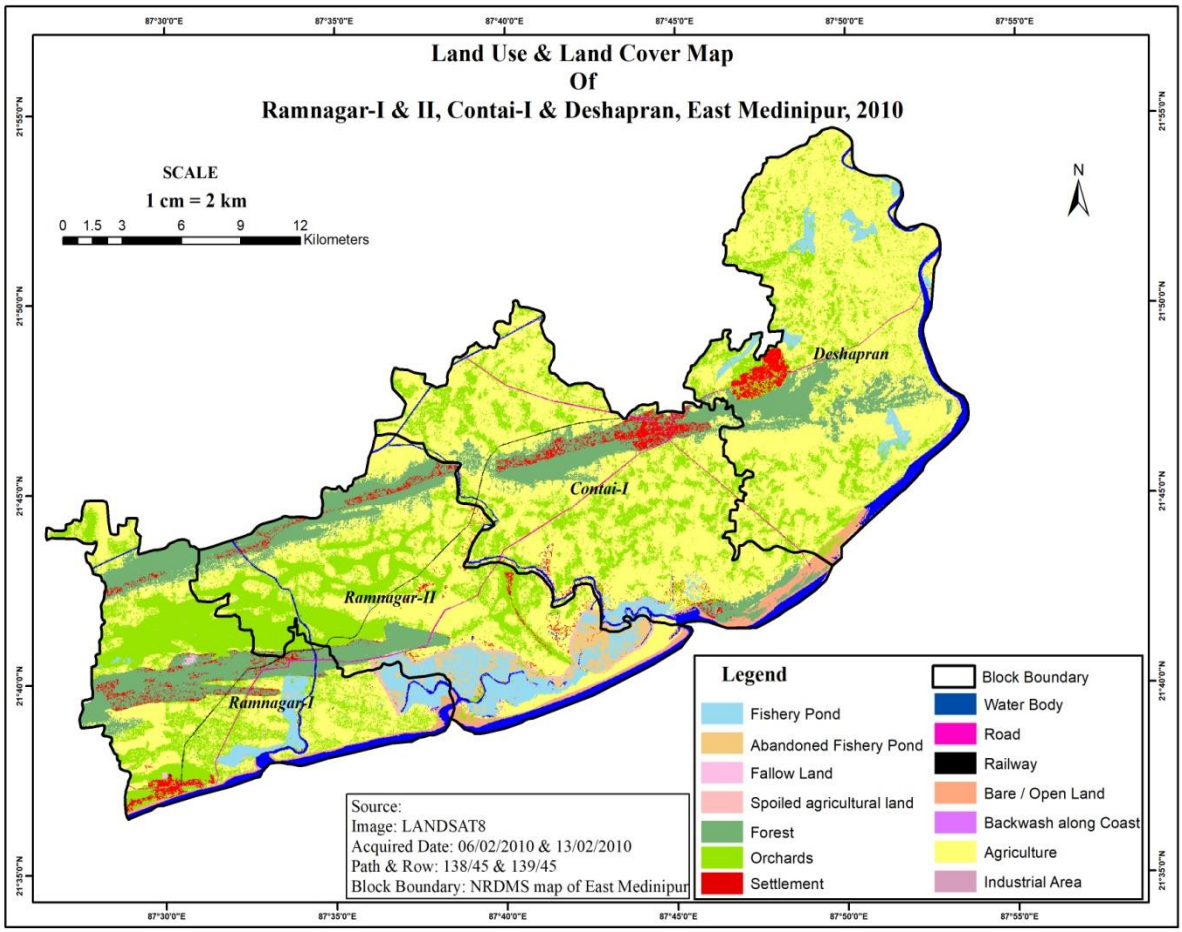


Fig: 1: Supervised land use maps of 2004 & 2007.



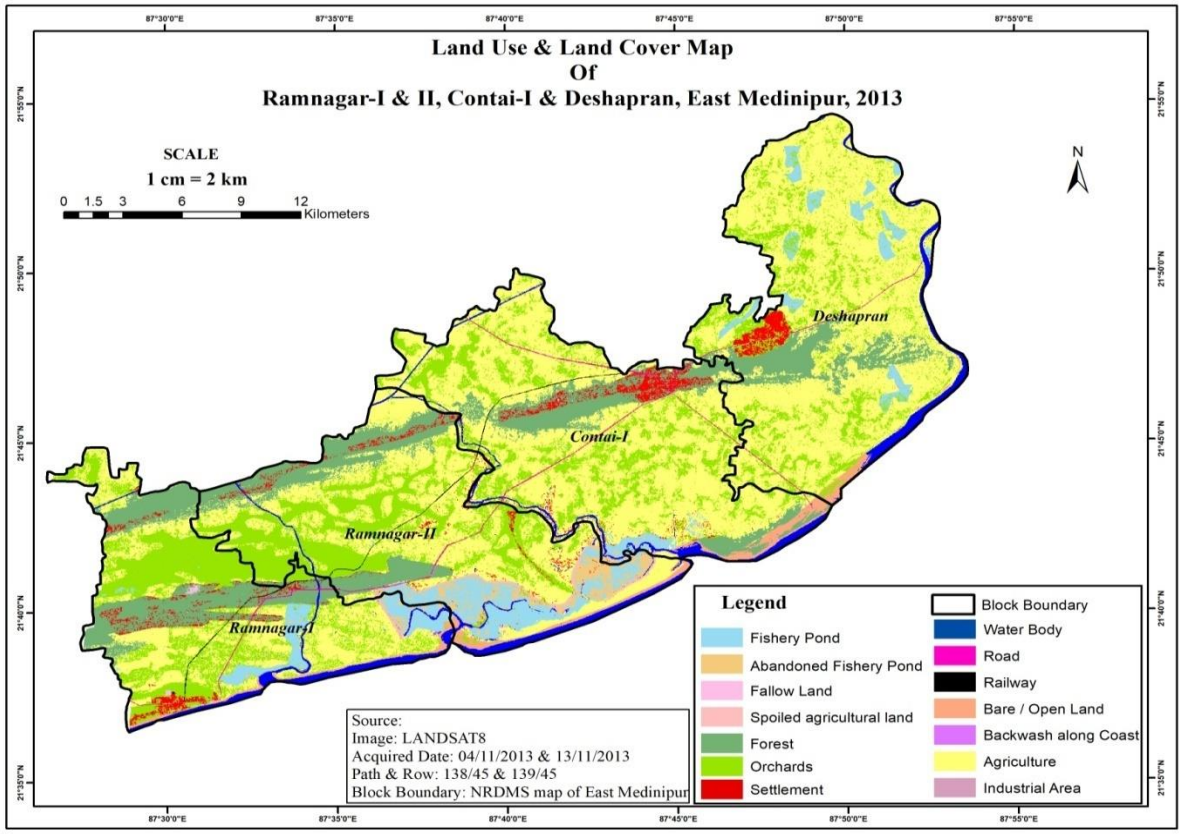


Fig: 2: Supervised maps of 2010&2013

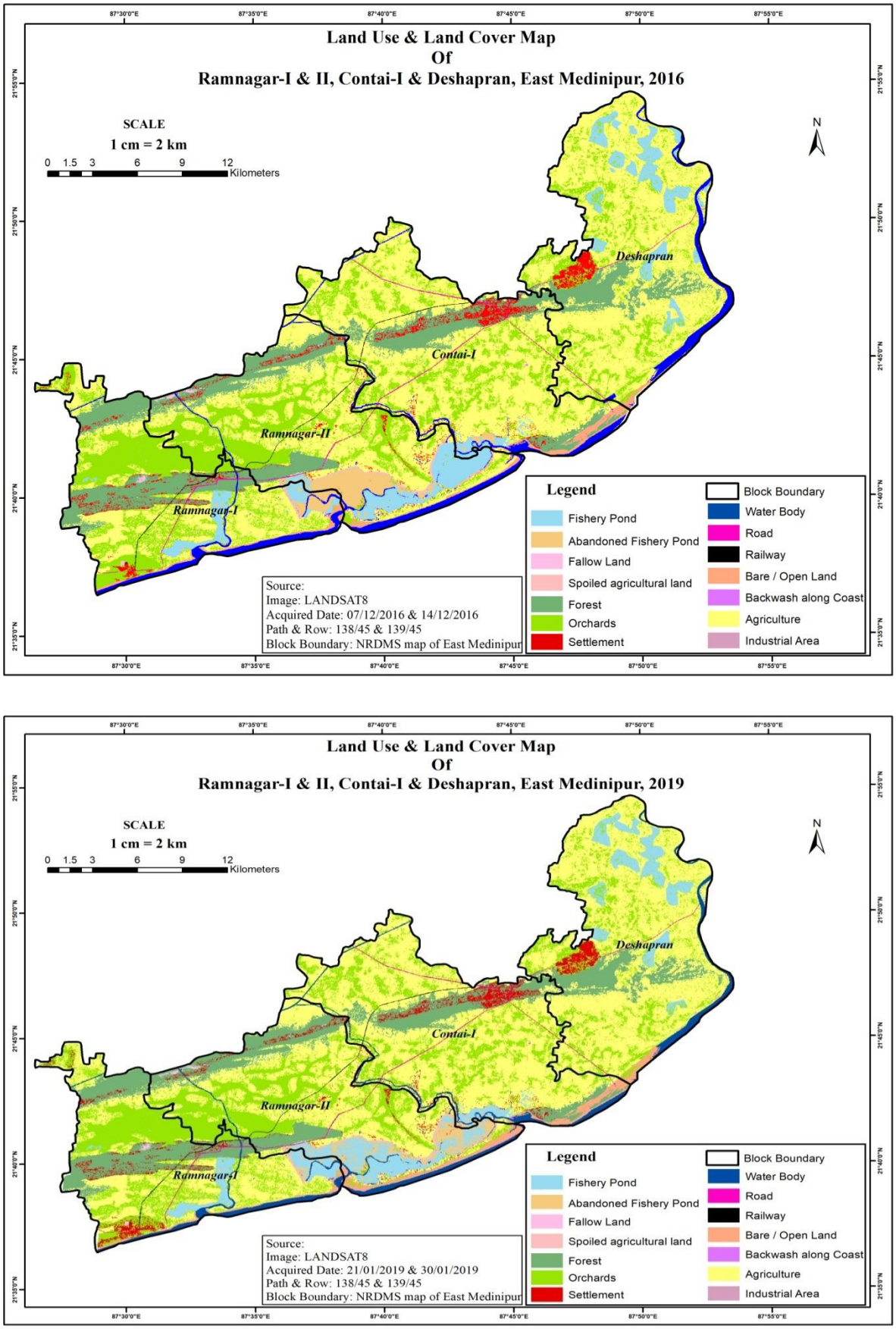


Fig: 3: Supervised maps of 2016 & 2019

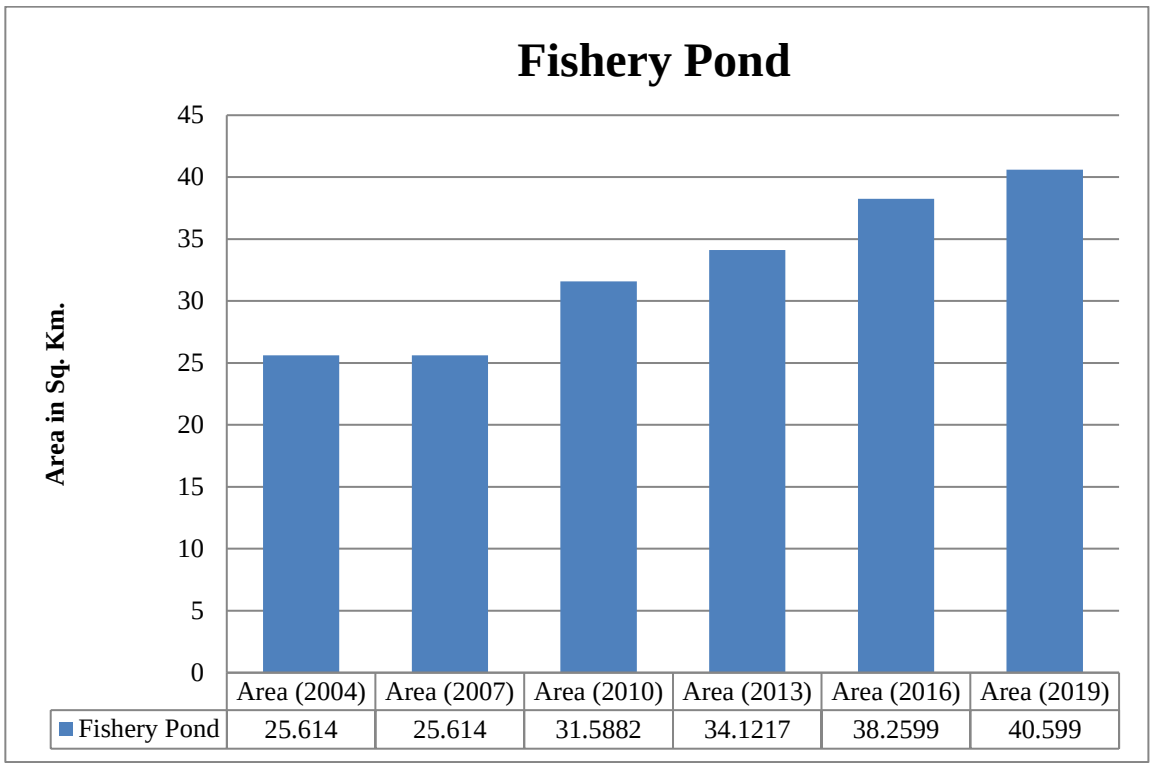


Fig: 4: Showing the changing trend of Fishery Ponds during the period from 2004 to 2019.

Figure no-4 reveals that there is a sharp increase happened after 2007. More than 9% increase has made in fishery ponds during the period from 2010 to 2019 i.e. within the span of nine years. This is due to the emergence of alternative occupation cum economy to the local people.

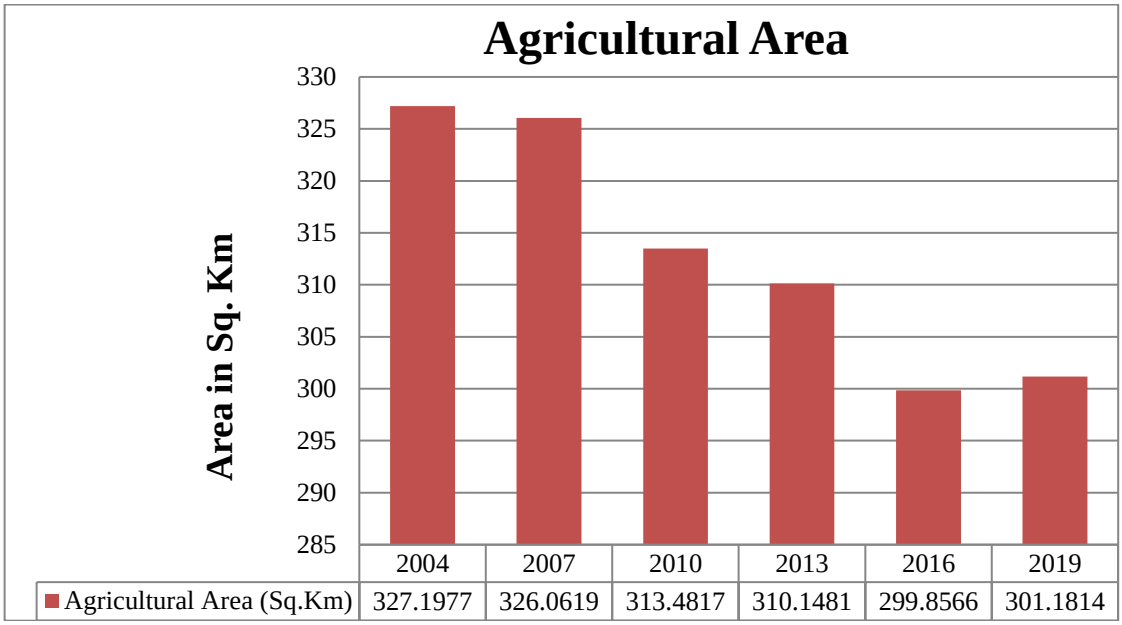


Fig: 5: Showing the changing trend Agricultural area during the period from 2004 to 2019.

In Figure no-5 it has been found that agricultural area has been decreased sharply after 2007. In 2004 the total agricultural land was 327.197 sq km, decreased to 326.06 sq. Km in 2007, 313.48 sq km in 2010, 310.15 sq km in 2013 and 301.18 sq. Km. In 2019. More than 25% decrease has been made in agricultural land during the period from 2010 to 2019 i.e. within the span of fifteen years. This is highly alarming for having self sufficiency food crop production.

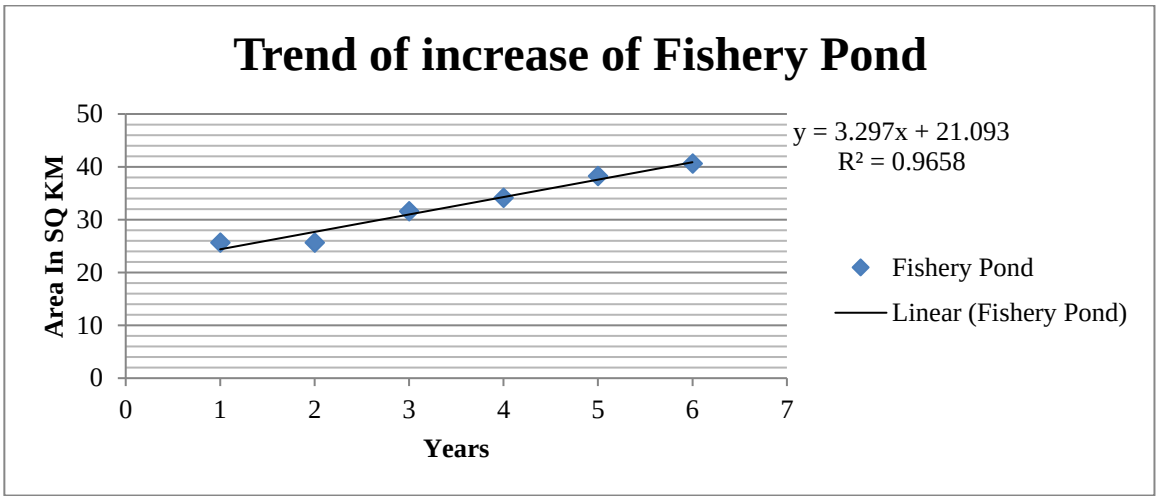


Figure no-6: Trend of increase of fishery pond.

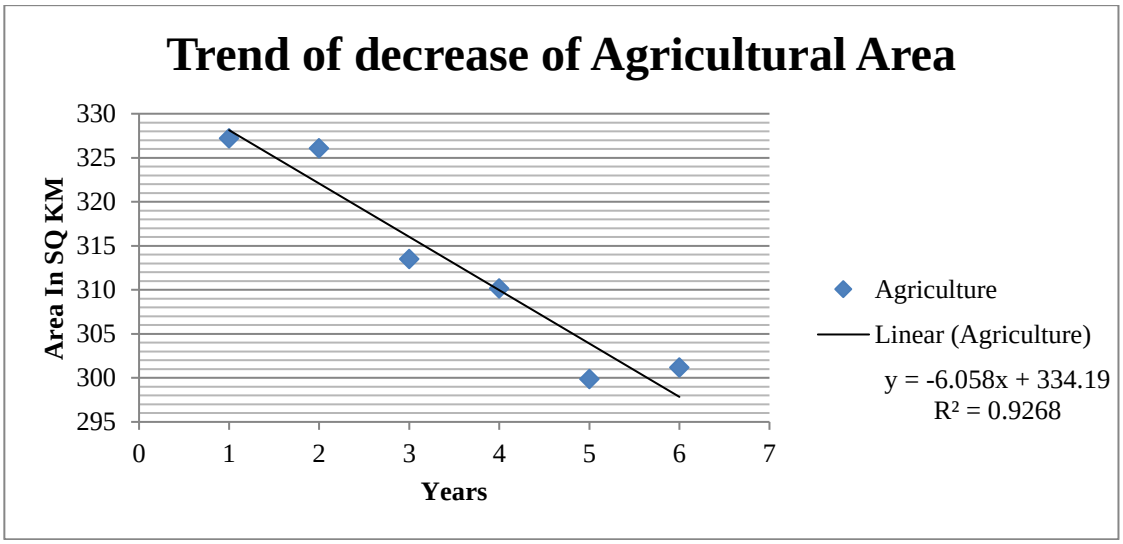


Figure no-7: Trend of decrease of agricultural area.

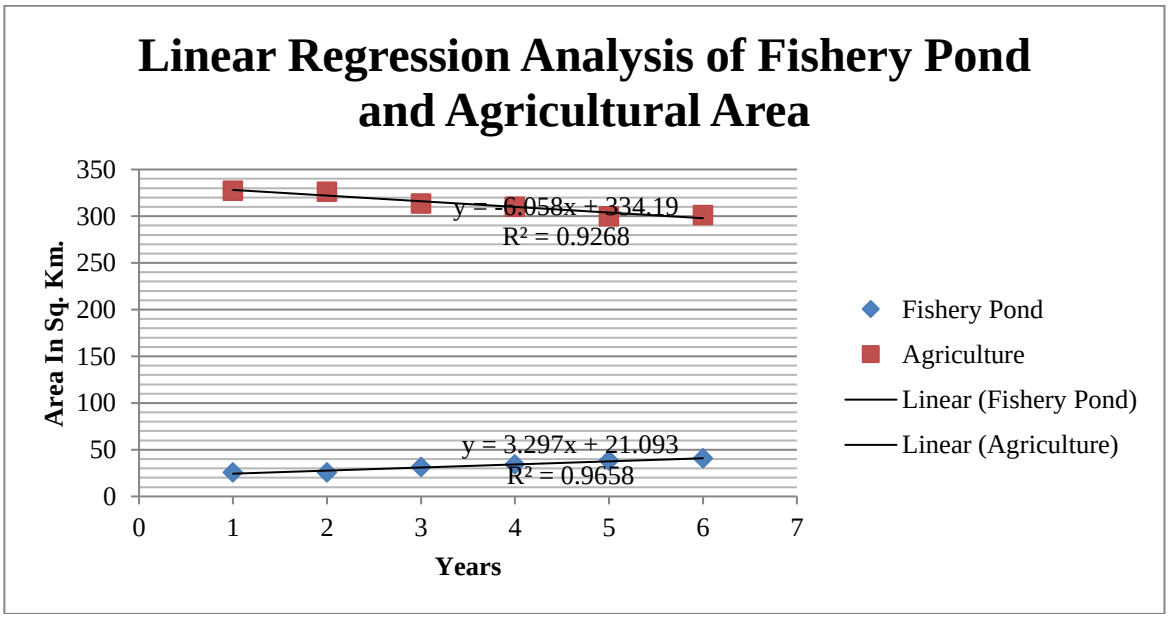


Figure no-8: Linear Regression Analysis of fishery pond and agricultural area

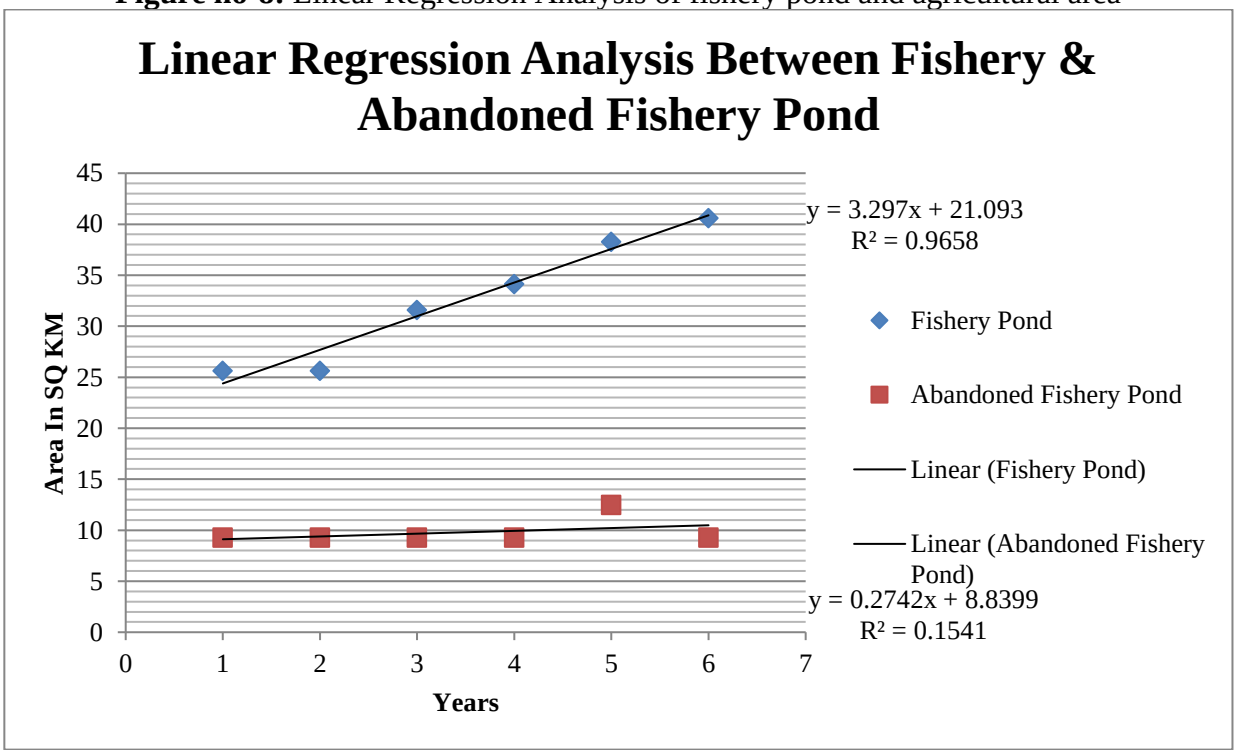


Figure-9: Linear Regression Analysis between fishery pond & abandoned fishery pond

Causes of land use change

1. **Growth of population**: Population growth is the main reason for the land use change. For the over population, it needs extra infrastructure. As a result, land use pattern have been changed. The rate of population growth is highly increased.

Table: Growth of population (1901-2001 and 2001-2011)

Name of Block	Growth of Population				
	1991	2001	Growth (%) 1991 - 2001	2011	Growth (%) 2001 - 2011
Ramnagar-I	129663	145418	12.15	167330	15.07
Ramnagar-II	123423	137358	11.29	156054	13.61
Contai-I	136898	150999	10.30	170894	13.18
Deshapran	132813	153041	15.23	176393	15.26

Source: District Statistical Hand Book of Purba Medinipur, 2014

2. Growth of infrastructure: Infrastructure growth is closely related to population growth. For the overpopulation, it needs extra infrastructure. With the growth of infrastructure, mainly agricultural land is decreasing. The main infrastructures of this study area are the following as-

i. Settlement: New settlements built up quickly for the pressure of overpopulation. For the fulfilment of the demand of overpopulation, there are growing up more and more settlements.

ii. Road: Road is another type of infrastructure that is one of the most important reasons for the reduction of agricultural land. Now increase the number of new roads and expand the old road like State Highway convert to National Highway, town road, village road, etc.

Table no-2 : Length of Road in the study area

Name of Block	Length of Road (km) maintained by			
	P.W.D	Zila Parishad	Gram Panchayat & Panchayat Samity	Pradhan Mantri Gram SadakYojona
Ramnagar-I	46	25	184	18.8
Ramnagar-II	37	27	480	41.0
Contai-I	38	96	290	53.86
Deshapran	29	66	286	37.25

Source: District Statistical Hand Book of Purba Medinipur, 2014

iii. Railway line: To develop the railway line, platform, and power stations; from Tamluk to Digha, plenty of agricultural lands have been damaged. In this study area, the total length of the railway line is about 33 km (Kanthi to Digha) and the number of stations is eight and there are several power stations.

3. Urbanization: Urbanization is the process of the spread of an urban area. Urbanization is such a process this the rural area turns into an urban area. For the urbanization the agricultural land losses at a high rate. Now the trend of living in urban areas is gradually increasing among the people. As a result, the urban area is being expanded and filling the agricultural land for building houses, shops, roads, etc.

4. Industrialization: Industrialization is another reason to reduce agricultural land. In this study area, mainly agro-based industries like the Cashew nut production industry, Mat making industry, rice industry, food processing industry and ice factory, brick making industry, storehouse, etc. are developed. As a result, land use pattern have been changed.

5. Tourism: As this study area locates along the Bay of Bengal, many tourist places have been developed. For the development of the tourism industry, many hotels, resorts, shops, and roads are being built. These are being made to fill all the agricultural land. Main tourist places are Digha, Shankarpur, Tajpur, Mandarmoni, Soula, Junput, Bankiput and Petuaghat.

7. Fish farming: Fish farming is the most important reason to reduce agricultural land. Fish farming is two types, freshwater fish farming and brackish water fish farming. In this study area, mainly brackish water fish are produced. Shrimp and Venami are the main brackish water fish which give people more profit than agriculture. That is why interest in shrimp farming is increasing. As a result, agricultural lands convert into shallow ponds. Over the last ten years, the agricultural land has been transformed into most of the fish farming for more economic earnings. Brackish water shrimp and venami farming have rapidly increased in the last ten years, but other reasons for the reduction of agricultural land gradually increase.

Consequences of decreasing the agricultural land

In the Kanthi coastal area, a lot of consequences are being noticed. The main consequences of agricultural land reduction are as follows

1. Land fertility decreasing: Land fertility is decreasing day after day in this study area. For the increase in food production, farmers are cultivating their land more intensively. and also, use more chemical fertilizer. For this causes land fertility is decreasing.

2. Food production decreasing: Due to the loss of agricultural land food production is decreasing gradually. Moreover, food grain and oilseeds production is also decreasing gradually.

3. Loss of Bio-diversity: Due to the loss of agricultural land and over population farmers intensively cultivate with HYV for increasing their production. For this cause, many traditional crops are almost lost their extinct. More over they are using pesticides for the release from insects and this is a cause of extinction of some environment-friendly faunal species.

4. Environment degradation: For the rapid reduction of agricultural land farmers cultivate their land intensively and use chemical fertilizer, pesticides, and other poisons. As a result water, air, soil, and other elements of the environment are polluted gradually.

5. Rising food price in the market: Due to the decrease in agricultural land yield rate is increasing for intensive farming, but net production is decreasing. For this reason, the Government imports necessary food crops, and food prices increase in the market.

6. Intrusion of saline water into agricultural land: For the increase of brackish water in shrimp farming saline water is entering the agricultural land from the fishery. As a result crop production is decreasing.

7. Fish production growth but food ineffective: For earning more economies, focus on brackish water shrimp farming and apply antibiotics with chemical fertilizer. As a result, fishes are food ineffective.

8, Lack of plant protein: Due to the loss of agricultural land decreasing the food diversity and creating a lack of plant protein among the people mainly the poor and child suffers from these problems.

9. Health impact: For the increase in food production farmers use more and more pesticides and chemical fertilizers which directly and indirectly impact on health.

10. Poor farmers are becoming poorer and the rich are getting richer.

Conclusion:

Consideration of the existing socio-economic scenario is necessary before implementing any sort of land use practices in the study area in future. It is expected that the findings of the investigation will undoubtedly be of use to planners and local bodies to implement suitable land use plans in the watershed, thereby achieving eco-preservation and enabling the restoration of degraded land units to the maximum possible extent. Local people must be made aware of the consequences of conversion of paddy fields. Land and water management activities must be conducted only after detailed land use planning, administrative measures should be taken to protect the agricultural land and to stop the unplanned and unauthorised conversion of agricultural land into fishing ponds.

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