Changing Trends Of Landuse Landcover In Nagaon District And Its Impact On Agricultural And Environmental Sustainibility

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Abstract:

Agricultural Landuse plays a vital role in the entire environment of the Nagaon district. Comprising of 3993 sq.km. of geographical area, the district reflects the spatio-temporal variations in agricultural landuse. In course of time the growing population stresses upon the agricultural landuse pattern of the district for fulfilling their various requirements like residence and day-to-day activities of livelihood. This interference of population and changing agricultural landuse effects the environment and the biotic ecosystem of the district, where man-animal conflict is also a common fact in some parts of the district. To achieve environmental sustainabilty, adoption of sustainable agriculture practices and enhancing agriculture productivity is highly needed.

This paper examines the changing trends of agricultural landuse of Nagaon district of Assam .The attempt is to reflect the agricultural landuse change dynamics occurred due to various natural and man-made factors.

For preparation of this paper, primary data are collected through questionnaires and personal visits with the local people in the field. Secondary data are collected from Govt. offices and websites.

Keywords: *agriculture, landuse change, environment, sustainable development.*

I. INTRODUCTION:

There is an assiduous debate all round the world and more in today's context on the role of environmental degradation and growth of population. And the inverse relationship between population and forest area had been recognized by different scholar around the world for the last century itself. Many studies conducted around the world had proved that deforestation was significantly related to the rate of population growth in different countries in Africa, Latin America, and Asia over the period 1968-78, and opined that population may be ascribed as a primary driver of deforestation in the developing world

As population grows the need to fulfill the demand of food also grows as a result there is an inverse correlation may be expected between population density and forest cover. In order to meet growing demand of basic requirement for living, people have to increase the cultivation area for food or had to increase the productivity of land or yield. This ultimately leads to deforestation and use of harmful fertilizers, pesticides and other measure to increase the productivity of crops which ultimately destroys the fragile environment to a large extent.

The pattern of agricultural landuse imitates the quality of the agricultural system of a region in terms of productivity, diversification and Commercialization, consistent with a desired state of agrarian affairs along with ecological balance of the region. The highest portion of agricultural land in Nagaon district is being occupied by the paddy cultivation followed by jute, sugarcane, tea and wheat in order. Land in Nagaon district is put to diverse uses and it plays an essential role in the entire economy of the district. But the growth of population in course of time stresses upon the economy and the entire landuse pattern of the district.

Agricultural landuse constitutes a dominant feature of the diverse uses of land for productive purposes. It includes not only the land used for growing crops and fodder, but also that for raising livestock, agro forestry and pisciculture also. But in the state like Assam, agricultural landuse mainly means the tilling of the soil for growing crops only, leaving a small area for grasslands, horticulture, pisciculture and dairy farming.
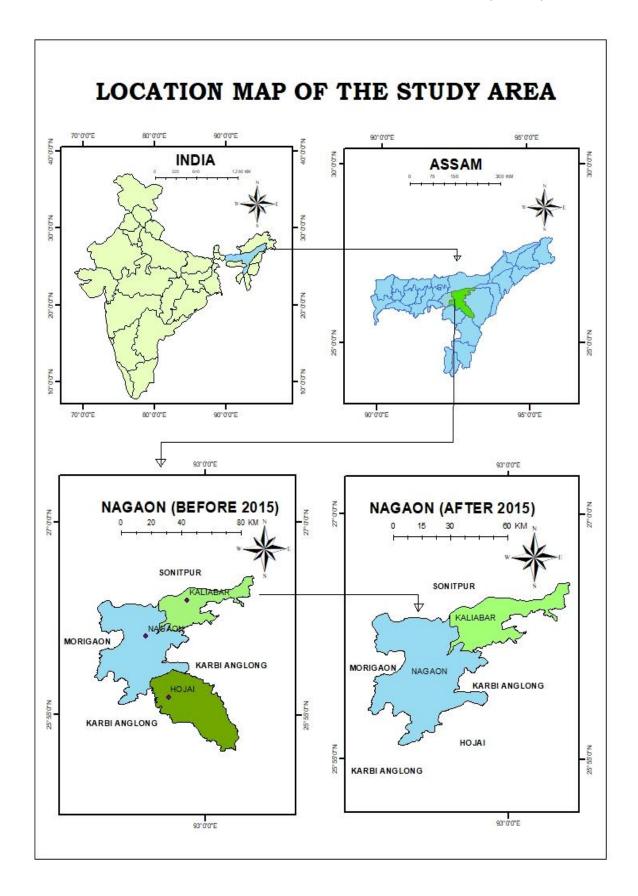
The pattern of agricultural landuse imitates the quality of the agricultural system of a region in terms of productivity, diversification and Commercialization , consistent with a desired state of agrarian affairs along with ecological balance of the region. The highest portion of

agricultural land in Nagaon district is being occupied by the paddy cultivation followed by jute, sugarcane, tea and wheat in order. Land in Nagaon district is put to diverse uses and it plays a essential role in the entire economy of the district. But the growth of population in course of time stresses upon the economy and the entire landuse pattern of the district.

II. PHYSICAL BACKGROUND OF THE STUDY AREA:

Nagaon district is situated in the very heartland of Assam and is situated in the south bank of the mighty river Brahmaputra and lies between $25^045"$ and $26^045"$ North Latitudes and 91^0 $50"$and $93^020"$East Latitude in the flood plains of the Brahmaputra. The district is bounded on the North by the Sonitpur district and the mighty Brahmaputra. On the South , it borders the West Karbi Anglong district, Hojai and Dima Hasao. On the East it is bordered by Golaghat district and Eastern part of Karbi Anglong district, while on the West it neighbors the Marigaon district. Originally the district was with two subdivisions viz., Nagaon and Marigaon. But in october 14th 1989, Morigaon subdivision was specified the status of a district. Thereafter Nagaon district consist of three subdivisions viz., Nagaon, Kaliabor and Hojai. In 15th August 2015, again Hojai has came out as a separate district.

Topographically, Nagaon district is more or less flat. But towards the east, the plain area progressively narrows down and as a result Karbi Hills project out in to the plain. To the west, the plains gradually widens up and amalgamate with the Kapili valley.

LOCATION MAP OF THE STUDY AREA

The river Kolong is the principal tributary channel of the Brahmaputra in Nagaon district .Formerly the Kolong used to take off from the river Brahmaputra in Hatimura , but due to the formation of an embankment along the Brahmaputra near Hatimura Parbat the Kolong was carried to an end at its source. Now it flows with the waters of three small tributaries viz,. Diju, Misa and Dipholu. The river Kopili is one of the main tributary of Kolong and rises from the Jayantia Hills(Meghalaya Plateau).

According to Jahan(1997), the soil of Nagaon district can be divided into following groups:

(i). *Laterite or Lateritic soils*: This type of soil is mainly originate in the southern part of the district. This type of soils is usually yellowish red in colour, poor in lime content, magnesium, nitrogen and potash but very much rich in iron, aluminum oxides and manganese. This type of soil favours rice and sugarcane cultivation.

(ii). *Red soils, red loam, and yellow earth:* This type of soils are predominant in the foothills region of Nagaon district. Silica and alluminium are the chief elements of this type of soil. Due to the absence of humus and nitrogenous substances, these soils are less fertile. Shifting cultivation is suitable for this soil.

(iii). *Alluvial soil*: Alluvium soil is found mostly in the middle part of the district, lying between the Kolong and the Brahmaputra valley. It is very acidic and rich in potash content. The soil is transported type and the leaching is very much prevalent during the rainy season. This type of soils is less productive and manuring is required.

The general climate of the Nagaon district is tropical humid. Usually south-west monsoon influenced the climate of the northern part of the district. The heavy rainfall is a distinctive feature of the Nagaon and Kaliabor subdivisions .The average annual maximum temperature of the district is 30.4° Celsius and the minimum is 19.8° Celsius. December and January are the coldest months of the year where minimum temperature ranges from 11.2^{o}C to 12.7^{o}C. From March to middle of November, the temperature is fairly high. July & August are usually the hottest months. The average altitude of the district is 60.6 m.

III. STATEMENT OF THE PROBLEM:

The pattern of agricultural landuse in Nagaon district extremely depends upon physical factors like topography, soil condition and climate as well as upon anthropogenic factors such as density of population, duration of occupation of the area, land tenure and technical levels

of the people. The agricultural landuse of the district is mainly dominated by the cultivation of rice, sugarcane ,wheat, maize and jute. Rice, being the staple food persist to dominate the region's agricultural practice. Still the agricultural landuse pattern in the region reveals area wise variation in intensity, acreage and layout in different agricultural crops in different levels.

The district also suffers from a variety of environmental, technological and socio-economic problems. Over dependency upon seasonal rain from monsoon is another main problem. Social problems like small size of agricultural land holdings, effects of caste, religion, level of literacy and education etc. largely hamper the agricultural landuse pattern. Economic problems like deficiency of capital, credit facilities, inadequate supply of modern inputs and insufficient infrastructural facilities are major influencing factors of agricultural landuse pattern in the area. Modern agriculture like HYV seeds especially of rice covers 68%of the total rice grown area(Source: Director of Agriculture and Economics office, Nagaon).

Irrigational facilities are not adequate, which results low intensity of cropping in an agricultural year .Considering the above conditions prevailing in the District, it has been selected to understand the changing pattern of agricultural landuse in the district. This inquest is primarily concerned with the total agricultural area, Land area under principal crops, Net and Gross irrigated areas, irrigated area under Principal crops.

IV. SIGNIFICANCE OF THE STUDY:

With the increasing population of the District, there exerts a pressure upon the fixed and inextensible land area. Majority of the people depends on agriculture as the main source of their livelihood. Major portion of the land in the district is used to cultivate winter rice (Sali) with a lesser degree of autumn rice (Ahu) and summer rice (Boro). Sugarcane is cultivated in the district with varying degrees and people are used to produces various types of molasses (guda) from sugarcane. Jute is another cash crop which covers a considerable portion of land under crop in the district. Tea is also cultivated in some specific agricultural land areas. In all these processes, it has been seen that people uses, misuses, under uses and overuses of land. With the growing population of the district, there is an urgent need to reduce the fallow lands . The study of agricultural landuse is considered to be more important in the district not only because there is practically no other significant source of economy except agriculture, but also because thousands of immigrants settled in the district during the twentieth century have altered the entire agricultural landuse pattern through the commercial cultivation of jute and

vegetables, creating a need for accurate cropping intensity and land utilization in a sustainable way.

Proper research is required to mitigate the aforesaid problems. So the present study draws its significance in bringing forth an appropriate agricultural landuse pattern for sustainable utilization of land in the district.

V. OBJECTIVES:

1. To find out the total agricultural land area used for growing Principal crops.

2.. To find out the share of irrigated areas of the district .

 3. To find out the irrigated area under Principal crops.

4. To find out the main influencing factors of agricultural landuse in the Nagaon district

5. To find out the proper measures towards the improvement of land use of the study area.

VI. METHODOLOGY AND DATABASE:

In this study Landsat 4-5 TM (Thematic Mapper), Landsat 7 ETM+ (Enhance Thematic Mapper) and Landsat 8 OLI-TIRS (Operational Land Imager/Thermal Infrared Sensor) multispectral satellite imageries linked for four epochs i.e. 1990, 2000, 2010 and 2020 were obtained from the USGS (United States Geological Survey) Earth Explorer with least percent of cloud cover to allow the analysis. Supervised classification is used in this study with maximum likelihood in ArcGIS software to categorize the land use/land cover, basically agricultural land along with four other categories for different years. An image enhancement technique was used to improve the interpretability and to provide better input for the classification. As the study is based on agricultural area changes, training samples for the agricultural area for all the four years has been selected mainly in association with few other categories and were processed using maximum likelihood classification in the ArcGIS software.
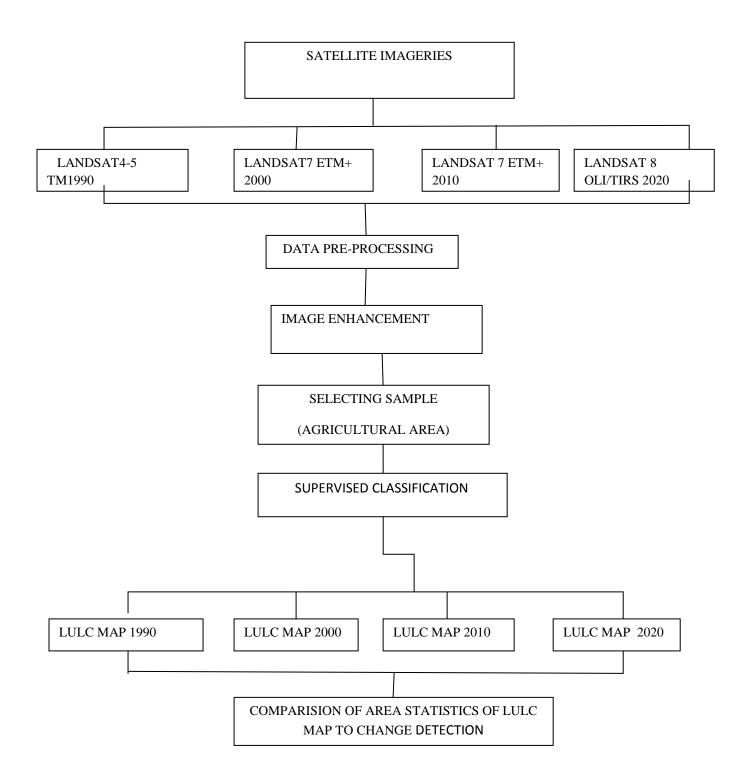
Table.1: Information about the satellite datasets used in this study

Satellite	Sensor	Path/Row	Acquisition Date	Spatial Resolution (m)	Spectral Band (s) (μm)	Data Source
Landsat 8	OLI/TIRS	136/42	2020/01/19	30	Band2(Blue):0.452 - 0.512 Band3(Green):0.533-0.590 Band4(Red):0.636- .673 Band5(NIR):0.851 - 0.879	USGS Earth Explorer
Landsat 7	ETM+	136/42	2000/12/2&2010/09/16	30	Band1(Blue):0.45-0.52 Band2(Green):0.52-.60 Band3(Red):0.63-0.69 Band4(NIR):0.76-0.90	
Landsat 4-5	TM	136/42	1990/08/28	30	Band1(Blue):0.45-0.52 Band2(Green):0.52-.60 Band3(Red):0.63-0.69 Band4(NIR):0.76-0.90	

The classification is also based on secondary information, local knowledge and visual interpretation of each class of land cover over satellite imagery and Google Earth. The district has been classified into five broad classes specifically agriculture , forest, settlement, water bodies, sandbars and others. Non agricultural areas are included under other category.Finally, the classified land use/land cover maps were analyzed and all the four maps were compared. Thereafter for each year the changes were detected and mapped accordingly. The study used supervised classification techniques for image classification to analyze the spatio-temporal trends in agricultural landuse changes during 1990, 2000, 2010 and 2020. Secondary information gathered from offices has been calculated and represented through simple cartographic techniques such as bar-diagram and pie-graphs .

Fig.1. Flowchart of Methodology

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│ LANDSAT4-5    │  │ LANDSAT7 ETM+   │  │ LANDSAT 7 ETM+│  │ LANDSAT 8     │
│ TM1990        │  │ 2000            │  │ 2010          │  │ OLI/TIRS 2020 │
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                    ┌─────────────────────────┐
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                    │   IMAGE ENHANCEMENT      │
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                    │   SELECTING SAMPLE       │
                    │  (AGRICULTURAL AREA)     │
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                    │ SUPERVISED CLASSIFICATION│
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│ LULC MAP 1990 │  │ LULC MAP 2000   │  │ LULC MAP 2010 │  │ LULC MAP 2020 │
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                │ COMPARISION OF AREA STATISTICS OF LULC │
                │      MAP TO CHANGE DETECTION           │
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V. DEMOGRAPHIC CONDITION:

According to 2011 census, Nagaon district has a population of 2,823,768, making it one of the highest populous district of Assam with a growth rate of 22.00% and 962 sex ratio. As per

2011 census, Nagaon district has a population density of 711 per sq km compared to states population density of 398 per sq.km.

Table.2.Nagaon district population growth, 1991-2011

District	Population census,1991	Population census, 2001	Population census,2011
Nagaon	1,82993,171	2,314,629	28,23,768

Source: District Economic and Statistics office, Nagaon, Assam.

Table.3. Nagaon district rural/urban population,2011

Description	Rural	Urban
Population(%)	86.91%	13.09%
Total population	2,454,234	369,534
Male population	1,250,985	188,127
Female population	1,203,249	181,407

Source: District Economic and Statistics office, Nagaon, Assam.

The population is mainly in heterogeneous in nature. Indegeneous Assamese communities along with tribal communities like Karbi, Lalung are the natives of the district. According to 2011 Indian census, the Muslims form a majority in the district with 55.36%. Hindus accounting for 43.4%, followed by 0.95% Christians. Small populations of Sikhs, Buddhists and Jains also reside in the district.

According to 1991 census, the total population of Nagaon was 1893171 with sex ratio 929, which increased to 2314629 with sex ratio 944 in 2001. According to 2001 census, the density per square km. is as high as 583, higher than the all Assam average of 340. Following this increasing trend, the district has a population of 2,823,768 of which male and female are 1,439,112 and 1,384,656 respectively with a density of 711person per square km.

Table.4: Decadal Percentage variation in Population of Nagaon District, since 1901.

YEAR	DECADAL PERCENTAGE
1901-1911	15.84
1911-1921	31.94
1921-1931	41.35

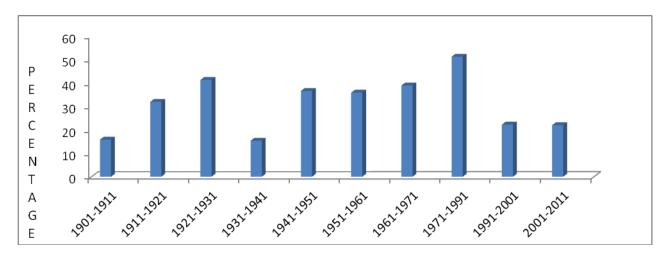| 1931-1941	15.37
1941-1951	36.65
1951-1961	35.91
1961-1971	38.99
1971-1991	51.26
1991-2001	22.26
2001-2011	22.09

Source: Census of India-2011

Fig.2. Decadal variation of population in Nagaon district, Assam (1901-2011)

There has been a change of 22.00 percent in the population as per 2001census and Nagaon district has recorded an increase of 22.26 percent from that of 1991. *Immigration* to Nagaon district is a most important factor which contributes to population growth.

In 2011, Nagaon district recorded the highest density of population recording as high as 711persons/km2, While Assam recording only 397 persons/km2, and India recording only 382 persons/km2

Table.5: Trend of Population density in Nagaon District, Assam, India,1901-2011.

Census	Density of Population(persons/km2)		
Year	Nagaon	Assam	India
1901	46	41	77
1911	53	49	82
1921	70	58	81

1931	90	70	90
1941	114	85	103
1951	156	103	117
1961	218	138	142
1971	302	150	177
1981	NA	NA	216
1991	494	286	267
2001	604	340	325
2011	711	397	382

Source: Census of India, Directorate of census operations, Assam 2011.

The trend of urbanisation in the Nagaon district has changed quite rapidly, and going by the decadal growth of different districts of Assam, Nagaon district accounts for second highest growth of urban population. Upon the limited natural resources of the district, rapid population growth has been generating enormous problem. Generally this growing population and urbanisation do not hold any responsible attitude towards nature or environmental issues. Anthropogenic activities for economic gain is the main concerning factor which is responsible for the change in agricultural land use in the district particularly in the last two decade.

CHANGING TREND OF AGRICULTURAL LANDUSE: This study aimed at examining the changing trend of agricultural landuse over 40 years. Environmental and local livelihood implications, soil degradation, biodiversity loss and forest cover decline are resulted from the changes. The LULC map drawn from the satellite imageries well reflects the changing trend of agricultural landuse in the district.

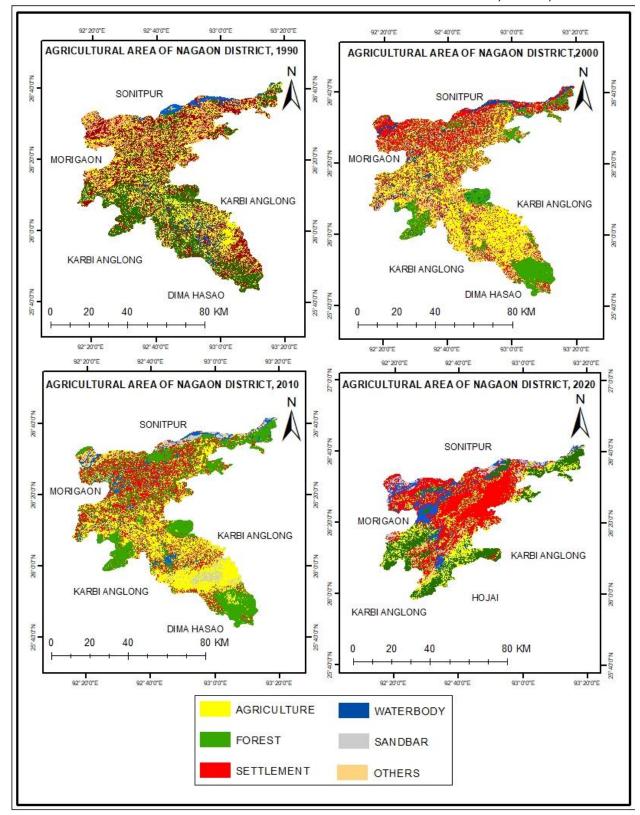Table.6. Landuse/ Landcover changes in Nagaon district,1990-2020

Landuse/Landcover	Year 1990	Year 2000	Year 2010	Year 2020
	Area in %	Area in %	Area in %	Area in %

Agriculture	24.61	25.10	30.01	18.33
Forest	18.20	16.33	14.19	6.16
Settlement	24.03	27.01	28.15	43.66
Water body	11.10	11.24	11.31	12.01
Sandbars	10.04	10.02	10.12	13.24
Others	12.02	10.30	6.22	6.62

Among the land use categories, agriculture occupies 24.61% in 1990 and decreases to 18.33% in 2020.While with the growing population settlement occupies continuously maximum area i.e 24.03 % in 1990 to 43,66% in 2020, which well reflects the rapidly growing population in the district . Most distressing fact is that dense forest area is significantly decreasing from 18.20 % in 1990 to 6.16% in 2020. The study reveals that the growing population has highly stressing on the limited natural resources of the district. Agricultural lands are relocated to residential areas. Similarly forest areas are cleaned up for agriculture and residence purpose. Ultimately the entire environment is exhausted. To maintain the ecological balance and sustainable utilization of resources, particularly this fixed resource i.e. land, proper measures are highly required.

The secondary data gathered from the Director of Agriculture and Economics office of Nagaon District reflects the changing Agricultural Landuse pattern of the district.

Table.7. Area under Agricultural landuse in Nagaon District,2002-03,2003-04,2018-2019

Category	2002-2003(Area in Hect)	2003-2004(Area in Hect)	2018-2019(Area in Hect)
Net Area Sown	235245	234569	205125
Total Cropped Area	373517	369862	339496
Area sown more than once	138269	135293	134371
Current Fallow	2707	3383	5845
Fallow Land other than Current Fallow	2057	2057	6002

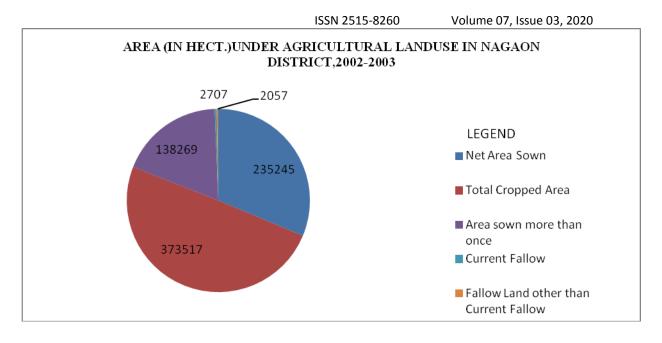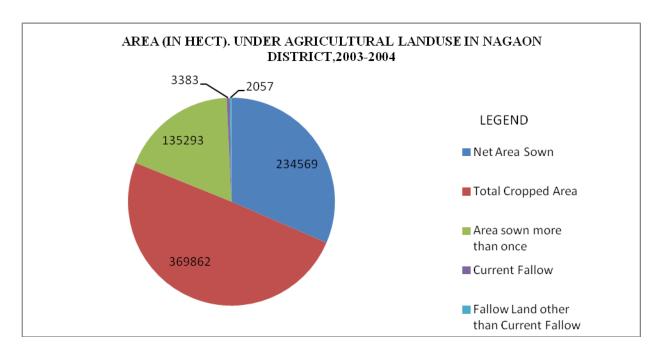Source: Director of Agriculture and Economics office, Nagaon

Fig.3. Area (in hect.) under Agricultural Landuse in Nagaon district,2002-2003

Fig.4. Area (in hect.) under Agricultural Landuse in Nagaon district,2003-2004

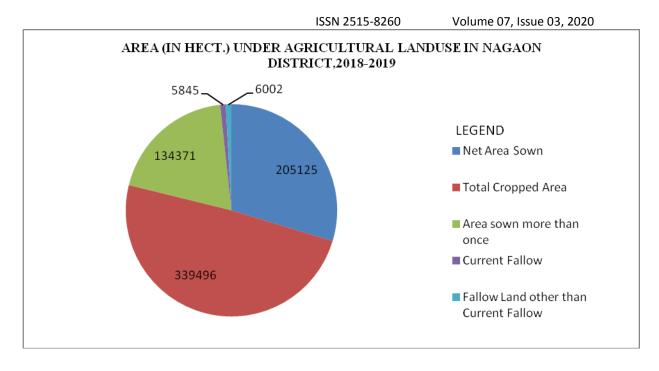**AREA (IN HECT.) UNDER AGRICULTURAL LANDUSE IN NAGAON DISTRICT,2018-2019**

Fig.5. Area (in hect.) under Agricultural Landuse in Nagaon district,2018-2019

Total Cropped Area of the district has been decreasing from 373517 hect. in 2002-2003 to 339496 hect. in 2018-2019. Current Fallow and Fallow Land other than Current Fallow are increasing. Present current fallow land amounts to 5845 hect. in 2018-2019 and Fallow Land other than Current Fallow amounts to 6002 hect. in 2018-2019. These fallow lands should be immediately make use to fulfill the demand of growing population of the district in a sustainable way.

Table.8. Agricultural landuse (Area in hect.) under different principal Crops.

Crops	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
Rice	231956	251279	252725	NA	NA	NA	192612	195199	183904	186251
Wheat	5699	5536	5732	NA	NA	NA	3100	3565	3655	3226
Maize	559	532	604	NA	NA	NA	398	88	415	435
Sugarcane	9142	8596	8044	NA	NA	NA	6296	7772	7198	6950
Jute	10666	11329	9682	NA	NA	NA	9548	9506	9955	9273

continued...

2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
192092	178355	196651	201733	198698	196850	196292	197935
3172	2840	2765	2456	2198	1868	1598	1249
428	453	529	546	579	598	614	638
6750	6249	6124	6176	6233	6312	6398	6434
9860	9670	10255	10378	10123	10109	9994	9956

Source: Director of Agriculture and Economics office, Nagaon

Table.9. Total Declined Area under (in hect.) under different principal Crops in Nagaon district, since 2001-2002 to 2018-19

Crops	2001-02	2018-19	Total decline
Rice	231956	197935	34021
Wheat	5699	1249	4450
Sugarcane	9142	6434	2708
Jute	10666	9956	710

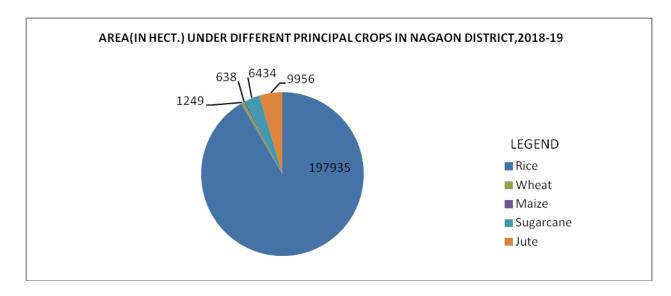Source: Director of Agriculture and Economics office, Nagaon

Fig.6. Area (in hect.) under Different Principal Crops in Nagaon district,2018-2019.

The data collected from secondary sources reveals that the area under Agricultural land is declining day by day. Among the principal crops, rice, wheat, maize, sugarcane and jute, all the areas are turn down because of population pressure in the district. People used to occupy the agricultural lands for filling their residential requirement. Area under rice was 231956 hect. in 2001-2002, which falls to 197935 hect. in 2018-19. Total 34021 hect. area of

Agricultural land was declined. Similarly,4450 hect,2708 hect,710hect land was declined in case of wheat, sugarcane and jute. Area under Maize only incresed, i.e. from 559 hect in 2001-2002 to 638 hect. in 2018-2020.

IRRIGATION FACILITIES IN THE DISTRICT: Irrigation facilities in the district is not adequate. Only 48320 hect of area is net irrigated in 2018-19 and 76547 hect area is gross irrigated in the same year. Different sources of irrigation are mainly Tanks and Tube wells, both Govt. and private in nature.

Table.10. Source wise Net Irrigated area(in hect.) in Nagaon District,2018-19

Canals	Tanks	Tube wells	Other wells	Other source	Total
24562	6475	2852	1166	13265	48320

Source: Director of Agriculture and Economics office, Nagaon

Table.11. Source wise Gross Irrigated area(in hect.) in Nagaon District,2018-19

Canals	Tanks	Tube wells	Other wells	Other source	Total
36759	8953	3962	1882	24991	76547

Source: Director of Agriculture and Economics office, Nagaon

Table.12. Irrigated area(in hect.)for Principal crops in Nagaon District,2018-19

Crops	**Area(in hect.)**
Rice	58728
Wheat	1049
Maize	90
Sugarcane	35

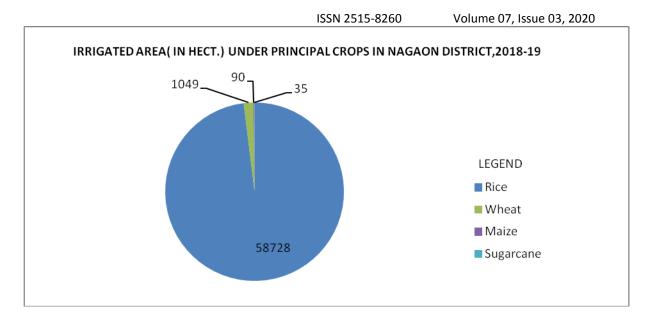Source: Director of Agriculture and Economics office, Nagaon

Fig.7. Irrigated Area (in hect.) under Principal Crops in Nagaon district,2018-2019

Area under Rice is irrigated about 58728 hect. Area irrigated for wheat, Maize and Sugarcane are 1049 hect,90 hect, and 35 hect, respectively in 2018-2019. For increasing the rate of production and crop intensity , farmers should be provided by proper irrigation facilities.

FACTORS OF CHANGING AGRICULTURAL LANDUSE: Different factors influence as well as control the pattern of agricultural landuse of the district. The factors which basically affect the agricultural landuse pattern of the district can be categorized under the head of Physical Factors and Socio-Economic Factors.

Physical Factors: Flood, Soil erosion, and Drought are the main physical factors which influence the agricultural landuse of the district. Soil erosion is a major problem for agricultural sector in some areas of Nagaon district. Heavy rainfall in summer resulting in a discharge of an unusually large volume of water causes heavy flood and the river torrents. This creates both sheet erosion and bank erosion in a number of rivers, mainly Kolong river.

The heavy flood of kolong and Kapili causes large scale soil erosion in the district and heavy sand deposits , wherein the land becomes unfit for further use in agricultural purposes and farmers compelled to change the plot of agricultural land ..Due to the lack of irrigation facilities and over dependency on monsoonal rain the farmers have to transform their cropping intensity and pattern.

Socio-Economic Factors: Socio-Economic Factors plays a chief role in changing agricultural landuse pattern of the district.. The social custom, beliefs and tradition has overwhelmingly

influence the agricultural landuse pattern.The rural populations of the district are mainly engaged in agricultural activities. The intensity of cropping in the district is very low. The intensity of cropping depends on the availability of irrigation and fertilizers. But both the conditions are not adequate in the district. The economic condition of majority of the farmer is very poor and they cannot afford to by manures, fertilizers etc. according to the need for agricultural development and to utilise agricultural land.

The size of landholding, fragmentation of agricultural plots comprises important effects on agricultural landuse. The distribution of operational holding in the district is found to be between 0.50-1.00 hectares(Source: Director of Agriculture and Economics office, Nagaon). Fragmentation of land holding is another major constraint in proper Land holding .

The non availability of skilled labour is another constraint in agricultural landuse in proper time.

Capital investment is another factor which carries the fruitfulness of the use of agricultural land in right sense. It comprises the implementation for tilling and leveling as well as use of inputs in the agricultural land like labour, power, seeds, manures, fertilizers, insecticides, irrigation and other elements of the infrastructure. But unfortunately the capital investment in agriculture is seen very low in Nagaon district.

Transport and Communication helps in commercialization of the agricultural products and thus   assists in the diffusion of agricultural innovations. A suitable and cheap transport system repeatedly inspires the farmers to increase their agricultural commodities through increasing crop intensity or adequate means of agricultural landuse.

Market is another important factor which influence the agricultural landuse in a greater way. It inspires them to re use of agricultural land and increase the cropping intensity. But market for agricultural commodities are not so equally developed in all parts of the district.

Man- Animal Conflict: During the field observation it is found that agricultural landuse pattern of the district is determined by the wild animals to some extent. Actually increasing population hampers on agricultural land for residential purpose and hence forest covers is cleaned up for agricultural practice and ultimately effecting the habitat of wild animals.There is a regular conflict between the wild elephants and the farmers .Due to the regular visits of the wild elephants from the hill slopes and forest areas ,the farmers have to restrict the some

practices in their agricultural land. The agricultural land used only to paddy practices also seriously suffers from the visits of the wild elephants. During the harvesting period of *winter rice* farmers have to harvest their crops even before it mature, otherwise the crops will totally damaged by the groups of wild elephants. It is worthwhile to mention here that due to this conflict the agricultural landuse patterns of some parts of the district are changing immensely .

EFFECTS OF CHANGING AGRICULTURAL LANDUSE ON ENVIRONMENT:

Effects of agricultural landuse on environment means the effect that different farming practices have on the ecosystems around them. This effect varies on the basis of wide variety of agricultural practices employed in the area, basically the production practices of the system adopted by farmers. In the district, the agricultural processes and techniques affects air quality and the atmosphere in four major ways: particulate matter and GHGs from land clearance by fire and the burning of rice residues; methane from rice and livestock production ; nitrous oxide from fertilizers and manure; ammonia from manure. There are two major types of indicators of environmental impact in the district: "means -based", which is based on the farmer's production methods, and "effect-based", which is the impact that farming methods have on emissions to the environment. The basic environmental issues that are related to agricultural practices of the district are climate change, deforestation, irrigation problems, pollutants, soil degradation, and waste.

FINDINGS: Major findings of the study area are as follows-

   (i)   Rice is dominant crop produced by all social groups.

   (ii)   Crop intensity is very low to feed up the growing population in the district.

   (iii)   The low cropping intensity indicates a poor agricultural development.

   (iv)   The multiple cropping systems is found to be more in the areas of immigrant population.

   (v)   Cash crop production in the district is low.

   (vi)   Irrigation facilities are not adequate.

   (vii)   Modern incentives from the Government are limited.

SUGGESTIONS: For the betterment of the agricultural landuse pattern in a sustainable way in the district following suggestions can be forwarded -

(i)   With the increasing population and to mitigate their need the use of fallow land is very necessary.

(ii)   Agricultural calendar should be prepared carefully for agricultural planning.

(iii)   Proper irrigation facilities should be provided to the agricultural field.

(iv)   Scientific crop rotation should be adopted very carefully, maintaining sustainable techniques.

(v)   Education and training facilities should provide to the farmers, such that the farmers will be aware of new techniques and innovations in agricultural production as well as proper land utilization process.

CONCLUSIONS: The use of agricultural land is essential to economic growth, human well-being, social equity, and ecosystem services. To maintain the environmental balance, the techniques and processes of agricultural practices should be necessarily in a sustainable way. This study regarding the changing trends of agricultural landuse in the district, reveals that it highly demands for the sustainable land management, which can aim to integrate the management of land, groundwater, biodiversity, and other environmental resources to meet human needs at the same time as ensuring the long -term sustainability of ecosystem services and livelihoods.

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