

Geospatial Analysis on Transitions of Land Use and Land Cover of Likabali C.D Block, Lower Siang District, Arunachal Pradesh, India from 2002 to 2022.

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Abstract

This study explores the transitions of Land Use and Land Cover of the Likabali C.D. Blocks, Lower Siang District, Arunachal Pradesh from 2002 to 2022 by using GIS, Land sat Series Satellite imaginaries. The Likabali C.D Block is consisting of two Likabali circle and Kangku circle for administrative purpose. The Land Use and Land Cover are being form as part of this research. By using the maps to identify and understand the modifications of Land Use and Land Cover. The maps classified such as forests, agricultural land, open space, and water bodies. Through the Land sat Series Satellite imaginaries the Likabali C.D Blocks landscape have significant change such as the rapid increase of open space and settlement areas and slight change of river sands. However, the agricultural lands likabali circles are decrease. The factors that influence those changes are Urbanization, natural disaster, demography change etc. The GIS was significantly used for spatial analysis and visualization. For more accuracy the field verification are also done for confirmation of land sat data. Through studies they provide right information's how modification of environment and human activities changes the Land Use and Land Cover of Likabali C.D Block.

Keys words: Geospatial, Land Use, Land Cover, Landscape, Likabali circle, Kangku circle, GIS

Introduction

The land transition is caused by natural and anthropogenic dynamic strength and its influence on environment. The land-use change refers to changes in the habits that inhabitants utilize or supervise an exacting area; these changes can incorporate changes in agricultural methods, urbanization, these changes are primarily determined by socio-economic factors such as urbanization and population growth, alongside environmental influences including climate change and natural disturbances. or other types of development (Verma et al., 2020). Involve the land use and land cover is critical in assess the effects of human activities on a given area (Baig et al., 2022).The idea of land use has changed because people in progress of using land resources for things like agricultural, industry, habitation, and resource extraction (Roy & Roy, 2010). But with time, these changes have regularly intensified into overuse and misuse, which has resulted in serious land degradation and natural disaster. Even though these challenges, this study uses a mixture of Google Earth photos, Landsats pictures, and detailed field verification to effectively categorize the land use and land cover of the Likabali CD Block. The investigation distinguishes involving several of dissimilar land use and land cover categories,

such as water bodies, bare rocks, river sand, agricultural land, settlements, and open areas. In spite of the difficulties accessible by the wide-ranging forest cover, this organization provides insightful information about the dynamic environment of the area that emphasizes the multifaceted relations between natural elements and human activity. By means of this technique, the study highlights how imperative it is to use progressive remote sensing methods beside with field support to get over the demerit of thickly forested areas.

Material and method

Study area

The Likabali CD Block is one of the three CD blocks of the Lower Siang District of Arunachal Pradesh. This CD Block consists of two Circles i.e. Likabali Circle and Kangku Circle. Among the three CD blocks, they are the most develop and better access of government schemes of the district. They are covering an area of 7.592 km². The average elevation of district is 200 m above mean sea level. The Likabali town as temporary headquarters, whereas Siji is the permanent headquarter of the Lower Siang District. The Likabali CD Block shares boundaries with Ramle Banggo CD Blok (New Seren, Nari and Koyu circles) on East side, Kamle District on West side the Subansiri river that demarcated the boundaries between Lower Siang District And Kamle District, Gensi CD Block (Gensi circl And Sibe circle) on North side. The Likabali CD Block also shares boundaries with Dhemaji and North-Lakhimpur District at South direction of Assam State. The Likabali CD Block consists of two administrative circles, Likabali circle and Kangku Circles.

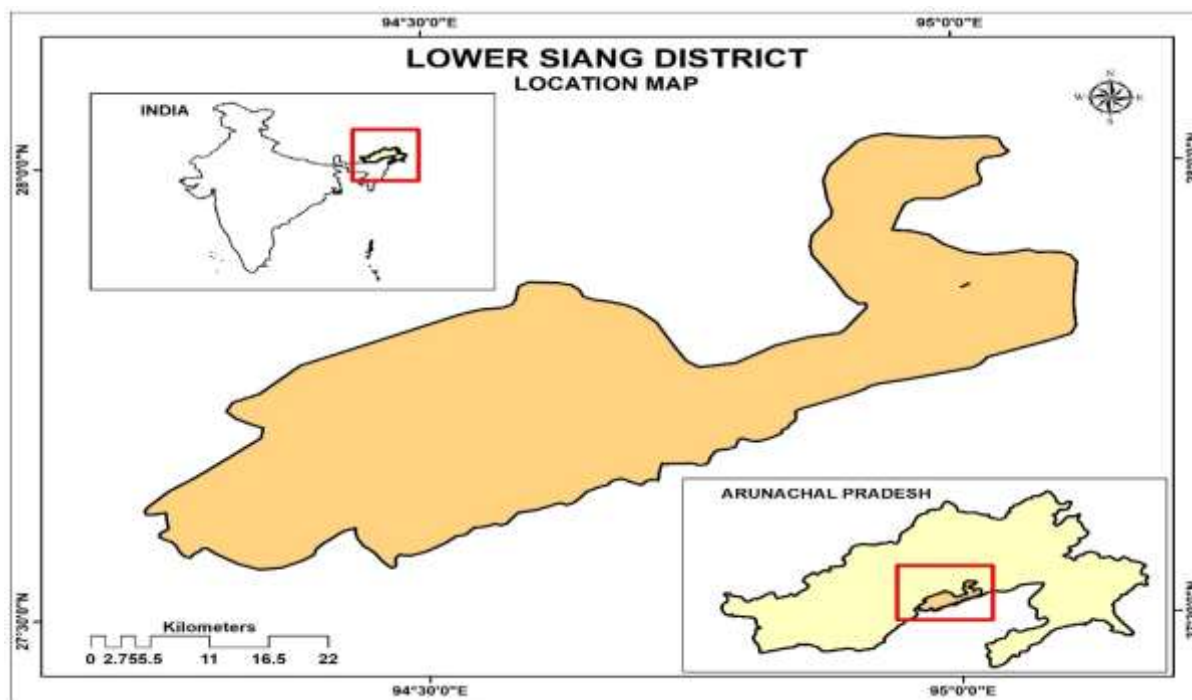


Figure: 1. Location Map of Study Areas.

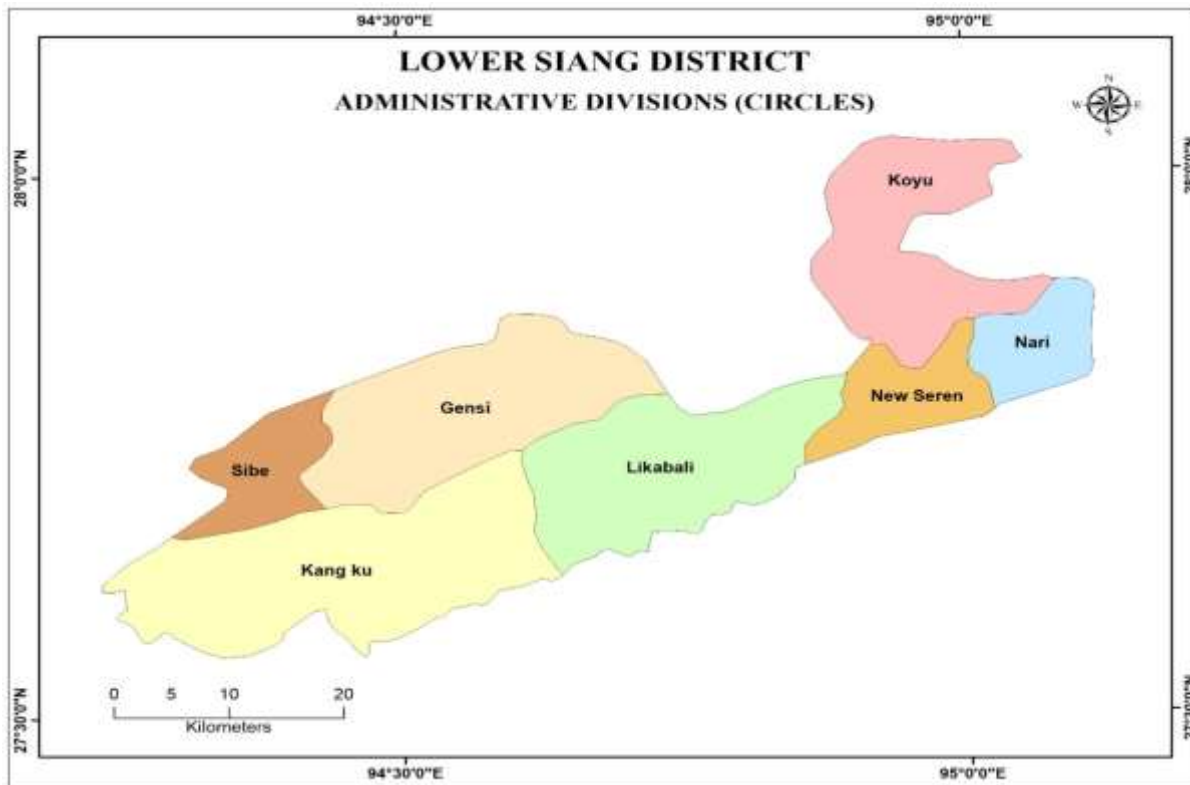


Figure: 2. Likabali C.D Block: Likabali circle and Kangku Circle

Physical Aspect

The physiographic of Likabali CD Block marks of Eastern Himalayas (Shiwaliks). The surface area of the Likabali CD Block has uneven relief like hills, mountains, plain and valley. The areas stretch out adjoining to Assam areas are generally plain. The Likabali circle and Kangku circle southern parts are mostly plains, but if we move towards the northern side the topography change into mountainous. As we move from the south to the north of the CD Block it has rough and hilly topography. The Likabali CD Block is mostly covered by different types of natural forests like semi-evergreen, evergreen, deciduous forest. In broad, the soil of the district is sandy loam to clay diverse with heterogeneous mixture and is acidic in some parts of the Two Circles. The Likabali CD Block consists of two major rivers; they are Siji River and Siyadhhol River. The Siji Rivers flows from Garu village of Gensi circle passes through the Siji village .This Siji River is also called Gainodhi in Assam; again they also merged with the Brahmaputra river. The Siyadhhol River is disbutires of Subansiri river that flow from Sibe circle through the areas of Balisori village of Kangku circle

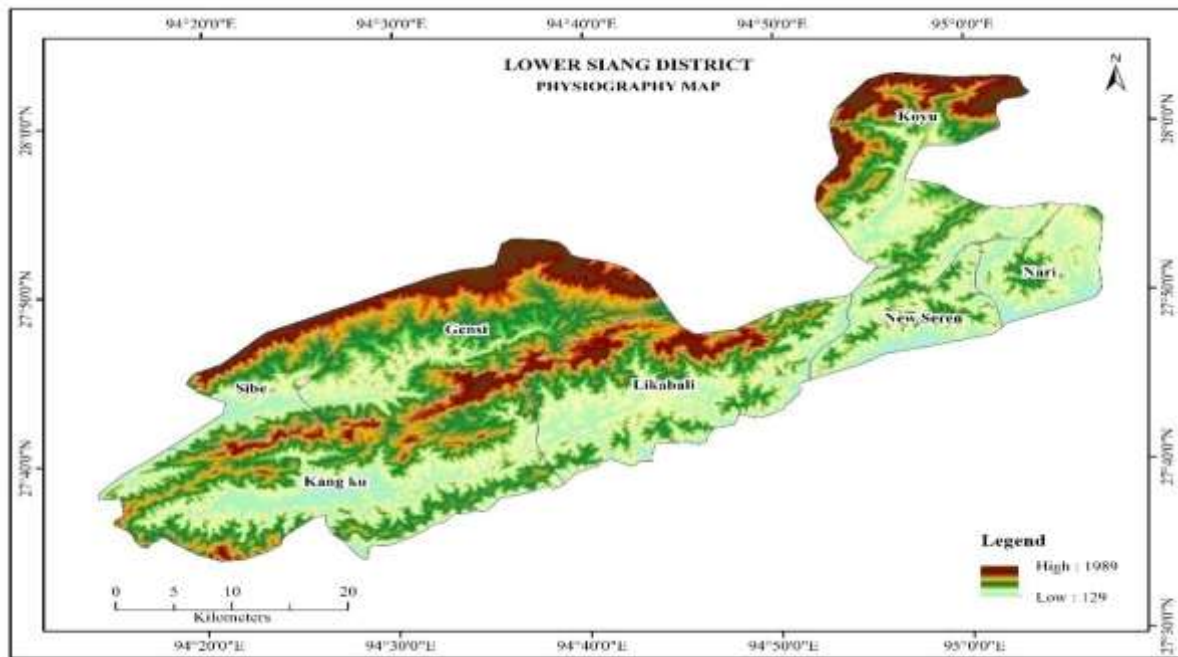


Figure: 3. Physiography of Lower Siang District.

The most prevalent climatic types of study area are humid sub-tropical, monsoon influence humid subtropical on south in plain areas and sub-tropical highland climate on northern side of the study area. The study areas experience heavy rainfall during May to September and caused landslides, soil erosion.

Cultural Aspect

As per the 2011 Census, The Likabali CD Block has 8,703 populations, from these populations there are 4,438 male and 4,265 female populations. The Likabali CD Block consists of 1,727 households. The Likabali CD Block has the highest populous of the Lower Siang District. The most of the peoples of this block is belong to Scheduled Tribes population called Galo Sub-tribes. The Blocks populations belief Christianity, Donyi Polo (Indigenous) are in major, they are considering different language/dialect such as Galo , Nepali, Adi, are indigenous , apart from that language they also spoke Hindi, Nepali, Assamesis, Mishing etc.

Significance of the study

The study of The Likabali CD Block assist to reduce the hazard of disasters and constructive resource for afterward studies by directing evidence-based policies and strategy that hold up environmental flexibility and sustainable development in the study areas. The land use and cover and Landscape dynamics study is significant since it provides vital new information about how anthropogenic action has affected the environment over two decades. The learn assists in identifying areas at threat of declining and provides information for protection efforts by investigative modification in land use and cover, such as transformation from agricultural land to built-up settlements and changes in forest cover up. So this assessment is obligatory for well-organized land use preparation and administration, which enables planner to hit a equilibrium between environmental sustainability and progress. The analyzing evaluation of environmental concerns shows the prerequisite of alert of risk-reduction strategy, such as landslides, flooding, soil erosion and

deforestation. The recorded modification in open areas, forest cover, and water bodies emphasize how essential it is to defend natural resources in order to preserve biodiversity and local livelihoods.

Objectives of the study

1. To analysis the land use and land cover transformation processes in Likabali CD Block of Lower Siang District, Arunachal Pradesh.
2. To understand the cause that determines the land use and land covers variation procedures.

Methodology

The Landsat 5, 8 and 9 series of satellite imagery from 2002 and 2022 and Qgis are used to study Likabali CD blocks. This study determines the spatial-temporal dynamics of land use, land cover and Landscape modification processes in the Likabali CD blocks of Lower Siang District of Arunachal Pradesh from 2002 to 2022. The research involves generating detailed Land use, Land cover and Landscape maps of Likabali administrative circles and Kangku administrative circle by processing and categories the high-resolution satellite images. These maps make possible to the classification and quantification of noteworthy shifts in land cover types such as natural vegetation, agricultural land, river sand, settlement, bare rocks, and water bodies. The study reveals that significant landscape changes, viewing by a decrease in forest and agricultural land and rise of open spaces and urban expansion. These modifications are mainly determined by socio-economic influencing such as urbanization and population growth, together with environmental factors including climate change, artificial and natural turbulence. To make sure the precision of conclusion, Geographic Information System (GIS) tools were use for spatial analysis and image, supported by field confirmation. The study gives significant insights into the relationship between environmental change and human activities.

Result and Discussion

1. The Likabali Circle Land use and Land Cover: 2002 and 2022

The land use and land cover data from 2002 of Likabali circle, that given on table 1. The natural vegetation and forest cover considered for nearly all of land use, across 305.866 km² or 96.6% of the whole area. The 1.23% of the whole area that is 3.900 km² was cover up for agricultural land. The 1.249 km² covered by bare rocks and open area that account for 0.40% of total areas. The 0.226 km² of areas (0.08%) was covered in river sand. The whole areas used for settlements were 4.336 km² (1.37%) and the water bodies maintained constant about 0.32% of total areas.

Sl. No.	Land Use/Land Cover Type		
	Categories	2002 (area in km ²)	2022 (area in km ²)
1.	Forest Cover/Natural Vegetation	305.866	304.761
2.	Settlements	4.336	5.374
3.	Agricultural Land	3.900	3.053
4.	Open Space/Bare Rocks	1.249	2.153
5.	Water Bodies	1.019	1.019

6.	River Sand	0.226	0.236
Grand Total		316.596	316.596

Table no: 1. (Land Use and Land Cover type of Likabali circle)

As per the table no: 1.1, the area is conquered by natural vegetation that building up to 304.761 km². The 96.26% of the total land area, as per data on land use and land wrap in 2022. The 0.96 % of the total area 3.053 Km² is cover up for agricultural land. There are 2.153 Km², (0.68 %) of unwrap land and uncovered rocks. The 0.236 km² (0.08 %,) are made up of the river sand. The Likabali circles land that used for settlement used of around 5.374 km² (1.70%).The 1.019 km² of the total areas of the circles is cover up (0.32%) of water bodies. The entire possessions measured, the data indicate that forest cover predominates, with considerable parts that allocated for open spaces, agriculture, and other uses.

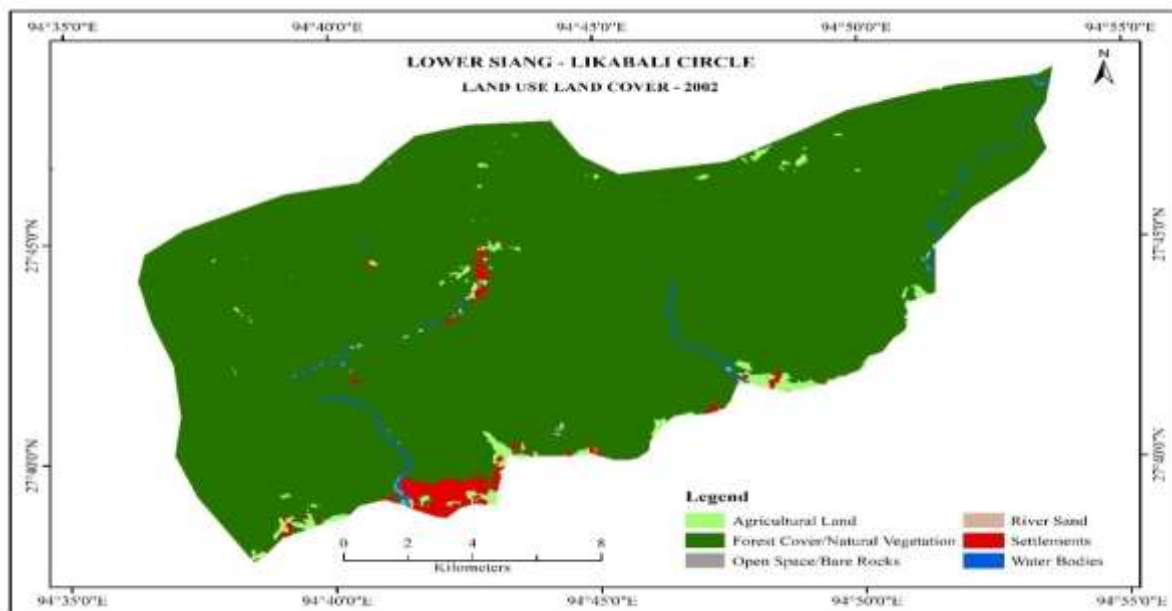


Figure: 4. Land use and Land Cover of Likabali Circle 2002

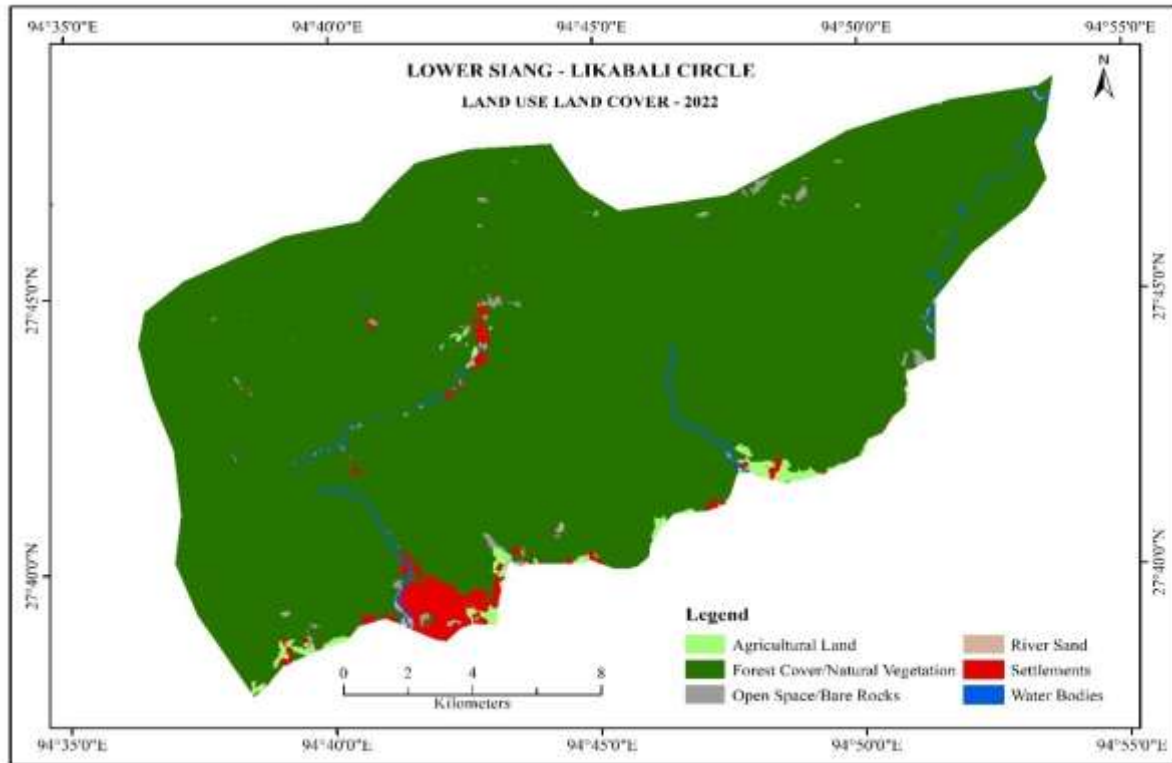


Figure: 5. Land use and Land Cover of Likabali Circle 2022

Comparison of land use and land cover of Likabali: 2002 and 2002

In Likabali, the total forest cover 96.60% in 2002 and 96.26% in 2022, there was a modest decline of 0.34% in the amount of forest cover and natural vegetation due to the process of urbanization mostly settlements, shifting cultivation, wet land farming and natural disaster like landslides, river erosion etc. however, the some villages are now doing plantation agriculture like rubber, orange, pineapple, betel nut and coconut. The construction of Trans Himalayan National Highway because in mountainous areas cutting of roads caused mass landslides that damaging of flora and fauna of that particular areas. The areas of 0.27% agricultural land decreased from 1.23 % in 2002 to 0.96 % in 2022 due to the shift of urban areas. The majority young youth are moving towards the secondary employment for self reliant, only few and old age populations of villages are stay to do the traditional agricultural method mainly shifting cultivation.

Sl. No.	Land Use/Land Cover Type	Area covered in % (2002)	Area covered in % (2022)	Transformed after 20 years (in %) with remarks
1	Forest Cover/Natural Vegetation	96.60	96.26	0.34% Decreased
2	Settlements	1.37	1.70	0.33% Increased
3	Agricultural Land	1.23	0.96	0.27% Decreased
4	Open Space/Bare Rocks	0.40	0.68	0.28% Increased
5	Water Bodies	0.32	0.32	0.00% constant
6	River Sand	0.08	0.08	0.00% constant

Grand total	100	100	
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Table no.2: Transformed of land use and Land cover after 20 yrs of Likabali Circle.

The main factors that influence the decreases of agricultural areas are due to the increase of literacy rate from 2002 to 2022. The supplies of free and least cost rice for every villagers that comes under Arnapuran Yojana (AAY), Below Poverty Line (BPL) an Above Poverty Line (APL) under the scheme of Public Distribution System (PDS). From 0.40% in 2002 to 0.68% in 2022, there was is noteworthy increase in open space and exposed rocks because of landslides on mountainous areas, rampant river erosion and soil erosion. One of the reasons that behind the increase of open space are due to flooding in study areas because the study areas lower part is usually plains areas. From 0.226 km² to 0.236 km² of river sand witnessed a slight increase. More interestingly 1.37% to 1.70% increase settlements because of breaking of family type .Earlier the Likabali circles have mainly nuclear and joint family and mainly depend on family heads only however, now a days the every family members have self reliant and built own house. The reasons behind the more settlement are due to increase of populations and constructions of government infrastructures. The areas covered by water bodies stayed steady at 1.019 km² of total areas.

2. Kangku Circle Land use and Land Cover: 2002 to 2022

The data of table no: 2. Illustrate the land use and land cover in 2022 signifies that natural vegetation and forest cover prevail that accounting for 98.66% of the total area. The 0.83% of the total area is used by agricultural land. The 0.30% of the total area is made up of bare rocks and open land. River sand makes up about 0.01% of the total area. The whole area enclosed by settlements about 0.23% of the land. The water bodies covered in Kangku circle is just 0.19% of the total areas. The maximum areas of Kangku circle is covers by natural vegetation of different forest types. So they sheltered the various animal, birds, plant species etc. The Kangku circle is primarily depended on the agriculture which is traditional shifting cultivation and wet land farming. However, the data of agricultural land are decreased because of urban effect. The age of working populations are migrated towards the urban areas for employment and better life. From the primary sources we reveal that main food crops of Kangku circle is rice, which is also main staple food for that area. The numbers of human settlement are slightly increased because of increasing population and bifurcations of joint family to single after the self reliant. It is worrisome that the open space of Kangku circle are increased may be due to flooding, landslides, etc. the data of river sand are remain constant.

Sl. No.	Land Use/Land Cover Type		
	Categories	2002 (area in km ²)	2022 (area in km ²)
1.	Forest Cover/Natural Vegetation	441.270	440.312
2.	Agricultural Land	3.848	3.698
3.	Settlements	0.937	1.025
4.	Water Bodies	0.852	0.855
5.	Open Space/Bare Rocks	0.315	1.332
6.	River Sand	0.042	0.042

Grand Total	447.264	447.264
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Table no.3: Land Use and Land Cover type of Kangku Circle

The statistics shows that the land use and land cover of 2002 exhibit that the key features were forest cover and natural vegetation, accounting for 441.270 km². The 98.66% of the total area are predominantly of natural forest. The 3.848 km², i.e. 0.86% of the total area was used for agricultural land. The land comprise of 0.315 km², that accounting of 0.70% of total land covered by open space and bare rocks. The river sand covered around 0.01% of the total that remains relatively invariable. The settlements spread across 0. 937 km² or 0.21% was covered and 0.19% of the entire area i.e. 0.852 km² was enclosed by water bodies. This sharing indicated that a little decline in the total of forest cover in contrast to 2022, steady river sand, modest population growth, and generally unwavering marine bodies, even though there were noticeable changes in agricultural land and open spaces.

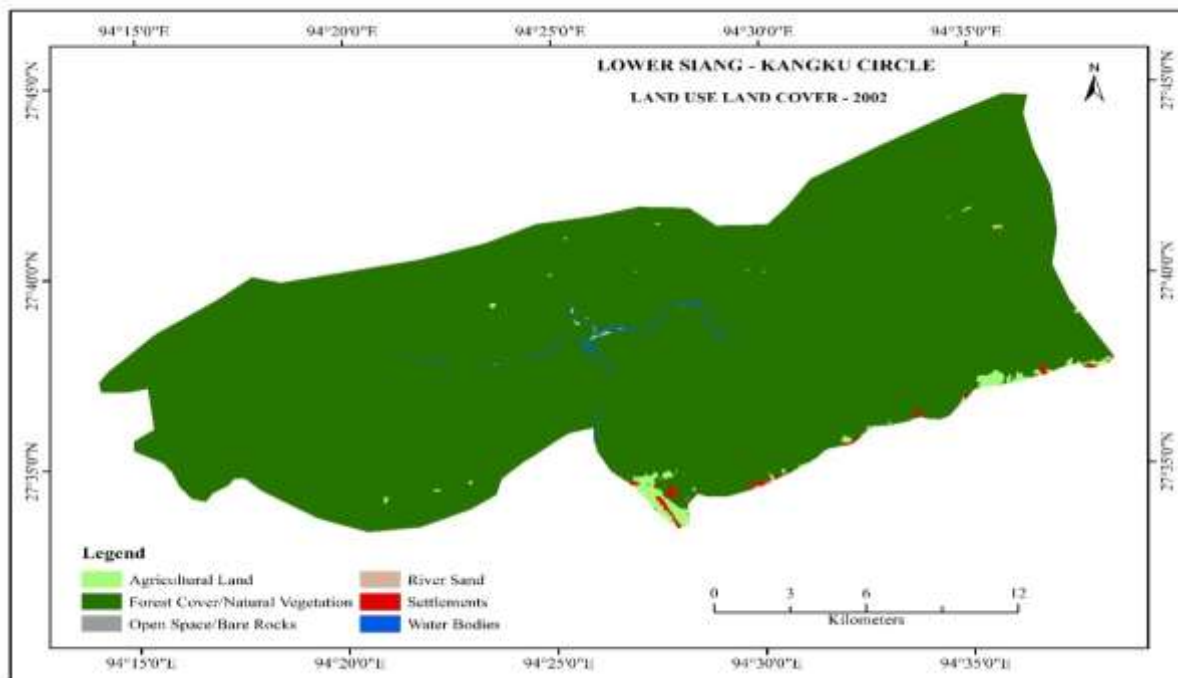


Figure: 6. Land use and Land Cover of Kangku Circle 2002.

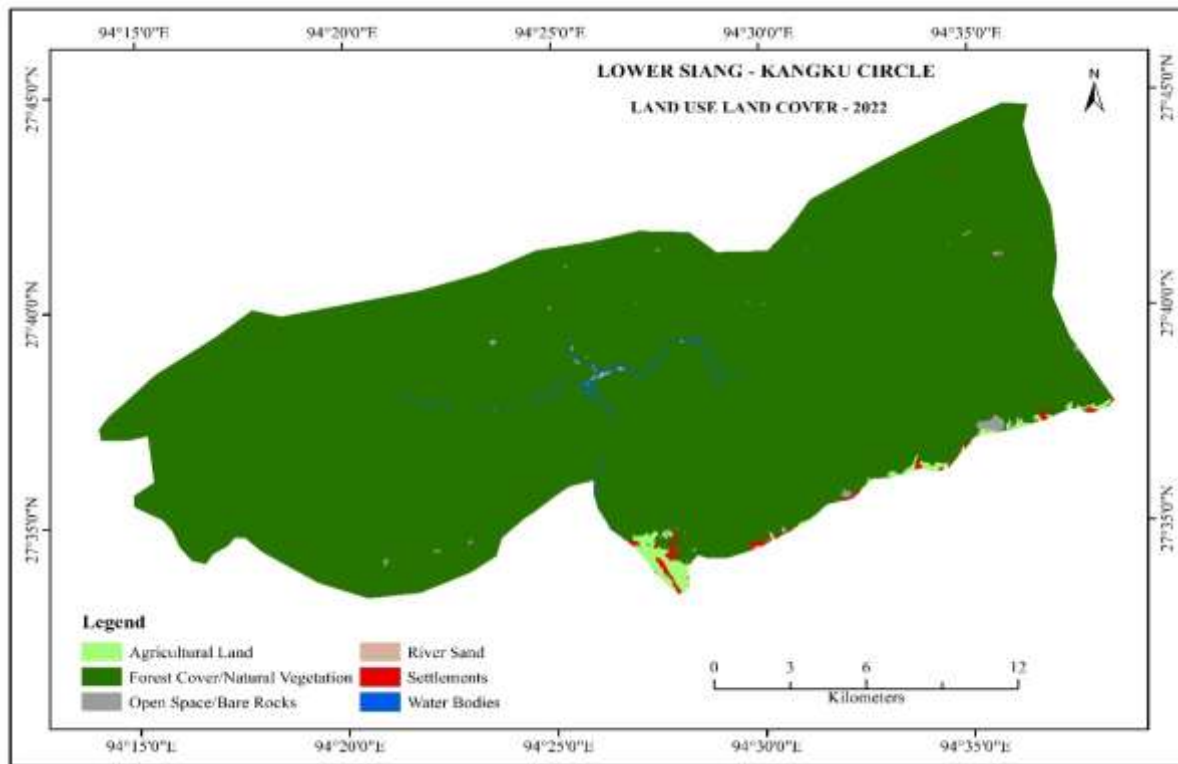


Figure: 7. Land use and Land Cover of Kangku Circle 2022

Comparison of land use and land cover of Kangku Circle: 2002 and 2002

More than a few considerable changes are manifest when comparing Kangku's land use and land cover data from 2002 to 2022. The quantity of natural vegetation and forest cover decreased slightly after two decade from 98.66% in 2002 to 98.44 % in 2022 of the total area that is the shrink of 0.22%. The reasons may be due to urban sprawl, natural disaster and anthropogenic activities that associated with the modern life activities. The 0.21 km² of agricultural land was replaced with 0.23 km² of land that slightly increased due to the increase of plantation farming. However, the significant decreasing of traditional agriculture likes shifting cultivation. The area of uncovered rocks and open space increased rapidly rising from 0.07 km² to 0.30 km² because of river erosion, landslides, and floods during rainy season. The study areas are located at the foothill of eastern Himalayas that is closely boundary with Assam. So, some areas have plain and sandy types of soil are found. The sand gravel soil types are more susceptibility to river erosion and flood that spread the sand soil and erosion.

Sl. No.	Land Use/Land Cover Type	Area covered in % (2002)	Area covered in % (2022)	Transformed after 20 years (in %) with remarks
1	Forest Cover/Natural Vegetation	98.66	98.44	0.22 Decreased
2	Settlements	0.21	0.23	0.02 increased
3	Agricultural Land	0.86	0.83	0.03 decreased
4	Open Space/Bare Rocks	0.07	0.30	0.40 drastically increased
5	Water Bodies	0.19	0.19	0.00 constant

6	River Sand	0.01	0.01	0.00 constant
Grand total		100	100	

Table no.4: Transformed of land use and Land cover after 20 yrs of Kangku Circle.

At 0.01% of the total area, river sand remained unchanged from 2 decades. From 0.937 km² (0.21%) to 1.025 km² (0.23%), there were more increased of settlements due to the urbanization, growth of populations and change of family types from joint and nuclear family to single family after self reliant. They also construct their own house without depend on parents. Water bodies slightly increased from 855,063.18 square meters to 851,999.93 square meters. The data signifies that on the whole, there has been an insignificant decline in agricultural land and a drastically rise in open spaces due to the flood, landslide, river erosions etc. that leads to the enlargement of open space. However, comparatively steady forest cover and small alterations to river sand, populated areas, and bodies of water.

Conclusion

This paper investigates the landscape change of Likabali Community Development Blocks of Lower Siang District, Arunachal Pradesh, which have two circles Likabali and Kangku. The analyses become very difficult due to the largely covered by the natural vegetation which normally makes other land use trends in satellite data. However, study precisely classified the land use and land cover inside study areas by images of Land sat, goggle Earth and field confirmation. The forest covers, agricultural lands, settlement, open space, river sand, bare rocks and water bodies. After study of the Likabali circles Land use and Land cover from 2002 to 2022, the forest cover or natural vegetation and agricultural land has decreased 0.34 % and 0.27% due to the shifting towards urbanization. The rapidly alteration of the open space or bare rock are observed due to the influence of flood, erosion, landslides that impact the environment of the study areas. However, the water bodies and river sand are staying steady as per result of analysis. The kangku circle's forest cover, settlement, and agricultural land are shrank due to sprawl of urbanization, moving of working population towards town and engaged in secondary activities. The influence of natural and anthropogenic activities such deforestations, land degradation, flooding, soil erosion, quarrying, compact settlement without proper drainage system the open space and bare rocks are significantly rise 0.40% over 20 years. The

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