



## **Land Use Land Cover Transformation in Kolaghat Block of Purba Medinipur District, W.B - A Short Term Analysis**

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### **ABSTRACT :**

This article aims to draw the attention of Land Use Land Cover (LULC) transformation from 2017 to 2023 in kolaghat Block, Purba Medinipur, West Bengal. Basically sentinel-2 satellite data has been used for the study of the region. According to the Sentinel-2 image, the LULC of the research area is divided into seven categories namely- water, trees, flooded vegetation, crops, built area, bare ground and range land. Arcgis, Google Earth pro, MS Excel etc. software is used to get the research results. In just five years (2017-2023), the amount of water has increased to 918.16 hectares. The main reason for this is the increase in the number of aquaculture field. In 2017, trees accounted for 9.82% of the total area of Kolaghat block but in 2023 it was only 3.44%. This decline is due to human activities and settlement construction. The amount of cropland has also decreased by 1598.26 hectares. In 2017, the built area was 30.78 percent, but in 2023, it was 40.22 percent. Such land use changes mark the earlier stages of urbanization.

**Keyword:** Land Use Land Cover (LULC), Transformation, Urbanization.

### **Introduction :**

Land cover is the biophysical state of the earth surface (Turner et al. 1995). Moser (1996) noted that the term “land cover” originally refers the type of vegetation that cover the earth surface. Land use involves both the manner in which the biophysical attributes of the land are manipulated and the intent underlying that manipulation and the purpose for which the land is used (Turner et al. 1995). In a similar way Skole (1994) stated that „Land use is a description of function, the purpose for which is land is being used, i.e. the management of land to meet human needs“ (Skole, 1994). Meyer and Turner (1994) stated that „Land use is the way in which, and the purpose of which, human beings employ the land and its resources (Meyer and Turner,1994). FAO (1995) stated the following definition of land use: “A series of operations on land, carried by humans, with the intention to obtain products and/or benefits through using land resources” (FAO,1995)

Land use and land cover refer to the human and natural features found on the surface of an area of the Earth. Whether there is information about the problems related to the planning of a particular place or the information about the natural resources present there and how to use those resources, we get to know the solution of these things by studying the land use and land cover pattern of that area. Although land use is generally inferred based on the cover, yet both the terms land use and land cover being closely related are interchangeable. For example, settlement is cover but if we include buildings whether it is being used for residence or industrial activity, it shows the land use component (Chaudhary et al, 2008; Gupta et al, 2024). In present time land use and land cover become a main element of makes strategies for managing natural resource and environmental change. It provides an overview of earth surface to understand human’s crucial activities on his natural resource base in time periods (Kaul, H. A., & Sopan, I. (2012)

Land use refers to human use of an area of the earth. Generally, the land is divided into sections, such as forest land, agricultural land, fallow land, pasture etc., informing the economic activity that takes place on the land. Land use and changes in it have a very important impact on the environment and ecology of an area (Anderson 1971; Arya et al. 1999; Chaudhary and Kumar 2017; Chaudhary et al. 2008). Among the issues related to natural resource conservation are the points related to land use conservation: soil erosion and conservation, soil quality enhancement, water quality and availability, vegetation protection, wildlife habitat, etc. Land use and land cover have different significance in their own ways and is the basis for Natural Resources Census. Land use is defined as a land which is used by different human activities like farms, industry, etc., or how land is utilized; land cover is slightly different (Xiubin 1996; Turner et al. 1994; Falcucci et al. 2007). Land cover is that land on which physical material is present at the surface of earth, like trees, bare land, etc. Land classification refers to different land types based on similar character. Land can be classified based on physical determinants such as soil profile, soil texture, and many different conditions, as well the purpose for which it is being used. Land Cover Classification considers biophysical individuality. Land Use Classification considers the serviceable use of land associated with human activities (Anderson et al. 1976).

### **Objectives**

Main Objectives of the study are given below-

1. To prepare Land Use Land Cover(LULC) map of the Kolaghat Block for the year 2017 and 2023.

2. To analyse the changes in Land Use Land Cover from 2017 to 2023.

## Study Area

Kolaghat Block (Previously known as Panskura-II Block) is one of the 25 Blocks in Purba Medinipur district of west Bengal. This Block situated between 22°21'43.392"N to 22°30'40.71"N latitude and 87°45'9.458"E to 87°54'4.774"E longitude. This Block is surrounded by the Rupnarayan river and Sahid Matangini Block in the east; by the Panskura Block in the west; by the Kangsabati river in the north and by the Sahid matangini Block in the south. According to 2011 census the Block consists of 13 Gram panchayat(GP) as well as 106 villages and 4 census town. These 13 Gram Panchayat are Amalhanda, Baishnabchak, Bhogpur, Brindabanchak, Deriachak, Gopalnagar, Pulshita, Khanyadihi, Kola-I, Kola-II, Sagarbarh, Siddha-I and Siddha-II; 4 Census towns are Kolaghat, Amalhanda, Mihirtikri and Kharisha. Area coverage of this Block is 15024.36 hectares, having 84.93% literacy rate and exists 2,90,124 populations after 2011 census, Govt. of India.

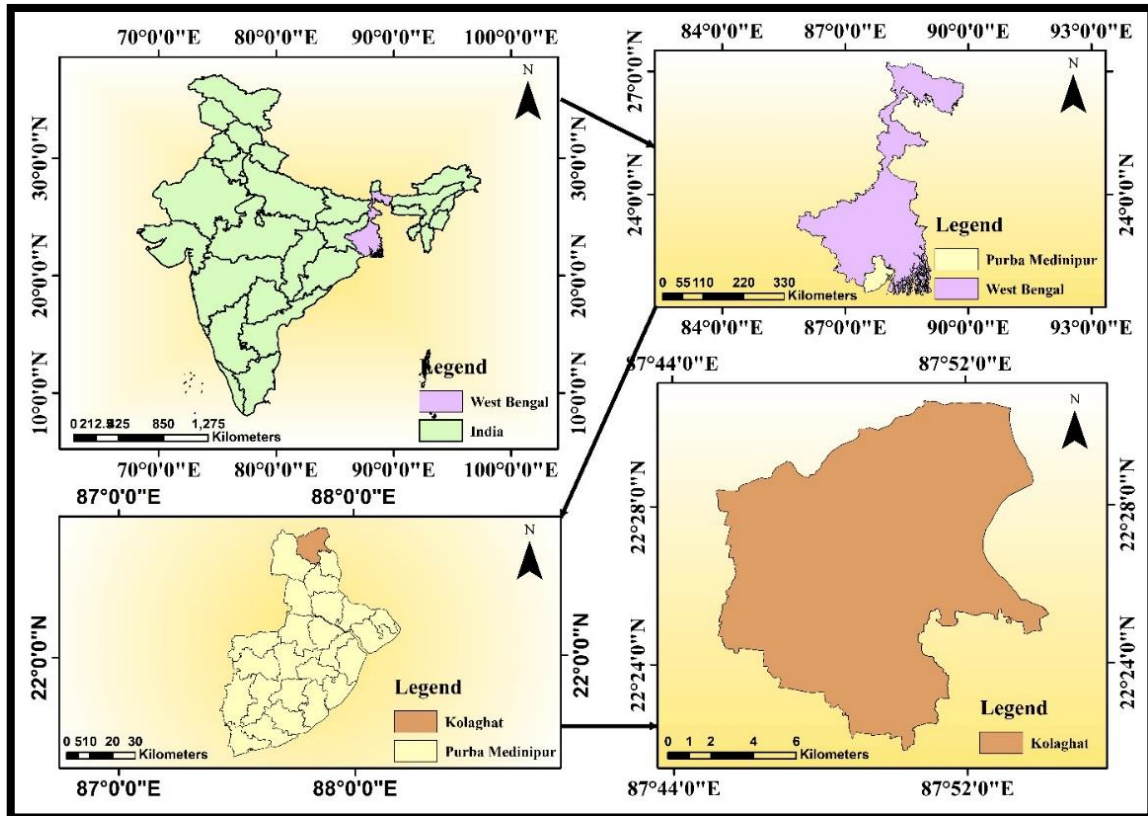


Figure-1: Locational map of the study area

## Methodology

Sentinel-2 Land Use Land Cover time series layer in the year of 2017 and 2023 has been applied for this study. The resolution of image is 10 metres. Sentinel-2 has been developed and is being operated by European Space Agency. Land Use Land Cover classes are given below according to European Space agency.

Table-1: land cover Classification scheme

LULC Classes	Description
Water	Areas where water was predominantly present throughout the year; may not cover areas with sporadic or ephemeral water; contains little to no sparse vegetation, no rock outcrop nor built up features like docks; examples: rivers, ponds, lakes, oceans, flooded salt plains
Trees	Any significant clustering of tall (~15-m or higher) dense vegetation, typically with a closed or dense canopy; examples: wooded vegetation, clusters of dense tall vegetation within savannas, plantations, swamp or mangroves (dense/tall vegetation with ephemeral water or canopy too thick to detect water underneath).
Flooded Vegetation	Areas of any type of vegetation with obvious intermixing of water throughout a majority of the year; seasonally flooded area that is a mix of grass/shrub/trees/bare ground; examples: flooded mangroves, emergent vegetation, rice paddies and other heavily irrigated and inundated agriculture
Crops	Human planted/plotted cereals, grasses, and crops not at tree height; examples: corn, wheat, soy, fallow plots

	of structured land
Built Area	Human made structures; major road and rail networks; large homogenous impervious surfaces including parking structures, office buildings and residential housing; examples: houses, dense villages / towns / cities, paved roads, asphalt
Bare ground	Areas of rock or soil with very sparse to no vegetation for the entire year; large areas of sand and deserts with no to little vegetation; examples: exposed rock or soil, desert and sand dunes, dry salt flats/pans, dried lake beds, mines
Range land	Open areas covered in homogenous grasses with little to no taller vegetation; wild cereals and grasses with no obvious human plotting (i.e., not a plotted field); examples: natural meadows and fields with sparse to no tree cover, open savanna with few to no trees, parks/golf courses/lawns, pastures. Mix of small clusters of plants or single plants dispersed on a landscape that shows exposed soil or rock; scrub-filled clearings within dense forests that are clearly not taller than trees; examples: moderate to sparse cover of bushes, shrubs and tufts of grass, savannas with very sparse grasses, trees or other plants

Source: Sentinel-2 images

Some statistical methods applied for this study. These are given below-

Magnitude change (K) =  $F - I_{F-I}$   
 Percentage of change (A) =  $\frac{F - I}{I} * 100$

(1)  
 (2)  
 Where, F= First date (2017)  
 I = Reference date (2023)

**Producer Accuracy**

=  $\frac{\text{Number of correctly classified pixels in each category}}{\text{Total number of classified pixels in that category (The Column total)}} * 100$  (3)

**User Accuracy =**

$\frac{\text{Number of correctly classified pixels in each category}}{\text{Total number of classified pixels in that category (The Row total)}} * 100$  (4)

**Overall Accuracy =**

$\frac{\text{Total Number of correctly classified pixels(diagonal)}}{\text{Total number of reference pixels}} * 100$  (5)

**Kappa Coefficient(T) =**  $\frac{(TS * TCS) - \sum(\text{Column total} * \text{Row total})}{TS^2 - \sum(\text{column total} - \text{Row total})} * 100$  (6)

Where, TS= total sample  
 TCS= total corrected sample

**Table-2: Rating criteria of Kappa Statistics**

Serial No.	Kappa Statistics	Strength of agreement
1	<0.00	Poor
2	0.00-0.20	Slight
3	0.21- 0.40	Fair
4	0.41- 0.60	Moderate
5	0.61- 0.80	Substantial
6	0.81-1.00	Almost Perfect

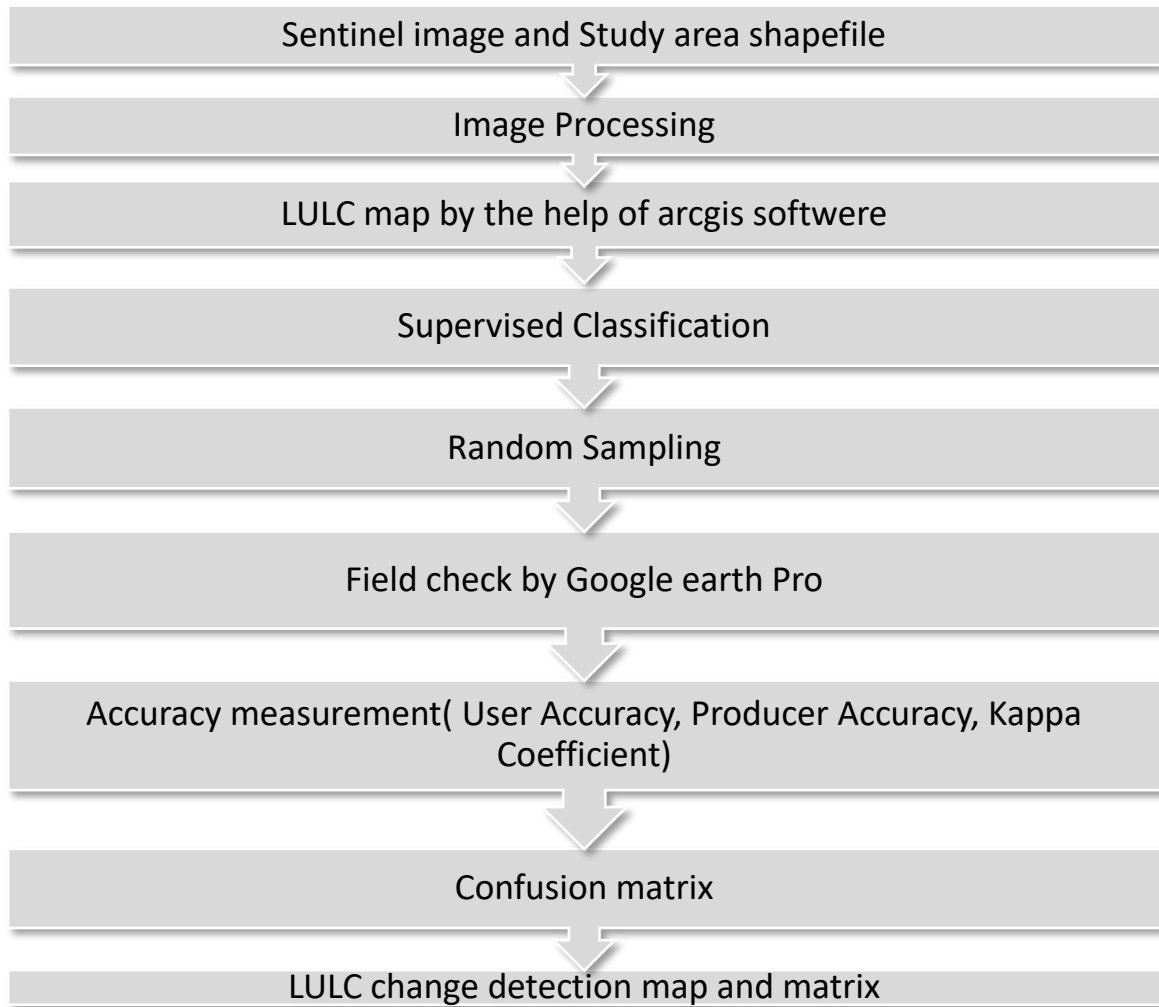


Figure-2: Flow Chart of methodology

## Results And Discussion :

Table-3 shows that in 2017, the area covered by water was 711.15 hectares, but in 2023, the area covered by water is 1629.30 hectares. In other words, water was 4.73 percent in 2017, but in 2023 it was 10.84 percent. In 2017, trees covered 9.82 percent of the total area of the block, but in 2023, trees covered only 3.44 percent. The magnitude change and percentage change of built area between 2017 and 2023 are 1418.05 and 30.66 respectively. Crop area has decreased by 1598.26 hectares in 5 years.

Table-3: Classified area, Magnitude change and Percentage change of LULC from 2017 to 2023.

Sr. No.	LULC Classes	2017		2023		Magnititude Change	Percentage Change
		Area (Hectares)	%	Area (Hectares)	%		
1	Bare Ground	3.76	0.03	0.74	0.00	-3.02	-80.20
2	Built Area	4625.03	30.78	6043.08	40.22	1418.05	30.66
3	Crops	8019.69	53.38	6421.43	42.74	-1598.26	-19.93
4	Flooded vegetation	36.16	0.24	29.26	0.19	-6.90	-19.09
5	Range Land	153.48	1.02	383.97	2.56	230.50	150.18
6	Trees	1475.10	9.82	516.58	3.44	-958.52	-64.98
7	Water	711.15	4.73	1629.30	10.84	918.16	129.11
	Total	15024.36	100.00	15024.36	100.00		

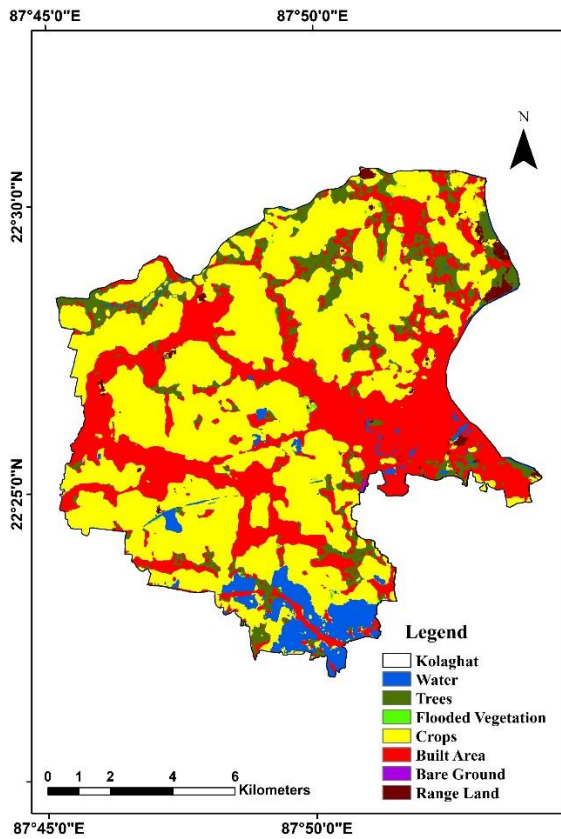


Figure- 3: Land Use Land Cover map in 2017

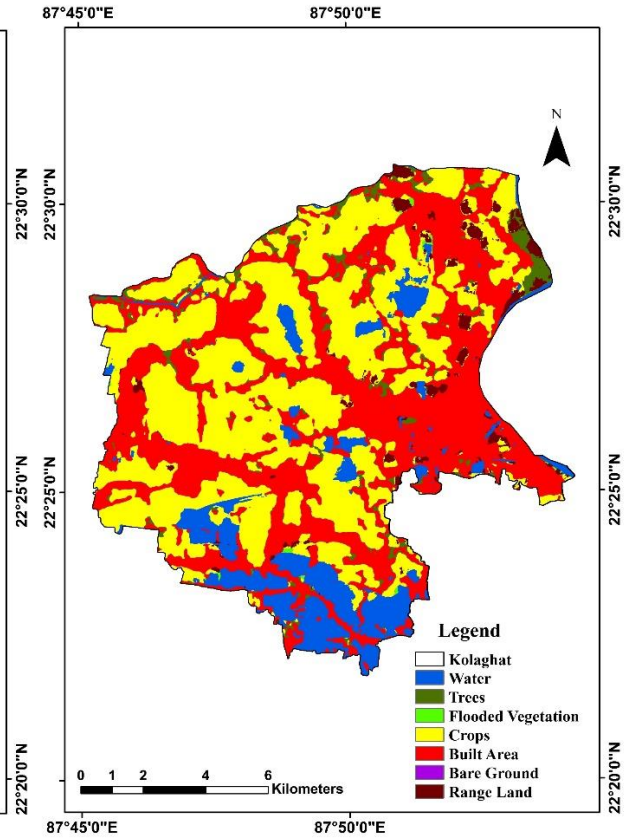


Figure-4: Land Use Land cover map in 2023

Table-4 exhibits that the relationship between ground truth data and the corresponding classified data obtained through error matrix report. This table shows the user accuracy value and producer value of different classes under LULC in 2017. The user accuracy values of water, trees, crop, built area and range land are 0.67, 0.63, 0.87, 0.87 and 1.00 respectively. Again the producer accuracy values of the classes are 0.57, 0.83, 0.92, 0.76 and 1.00 respectively. Also overall accuracy value and kappa accuracy value are 0.84 and 0.73 respectively.

Table-4: Confusion matrix table of LULC in 2017

Classes	Water	Trees	Crops	Built Area	Range Land	Total	User Accuracy(%)	Producer Accuracy(%)
Water	4	0	1	1	0	6	0.67	0.57
Trees	1	5	1	1	0	8	0.63	0.83
Crops	0	1	48	6	0	55	0.87	0.92
Built Area	2	0	2	26	0	30	0.87	0.76
Range Land	0	0	0	0	1	1	1.00	1.00
Total	7	6	52	34	1	100		
Overall accuracy: 0.84							Kappa accuracy: 0.73	

Table-5 describes the user accuracy value and producer value of different classes under LULC in 2023. The user accuracy values of water, trees, crops, built area and range land are 0.89, 0.75, 0.91 and 0.95 and 0.33 respectively. Again the producer accuracy values of the classes are 0.89, 1.00, 0.93, 0.86 and 1.00 respectively. Also overall accuracy value and kappa accuracy value are 0.90 and 0.84 respectively.

Table-5: Confusion matrix table of LULC in 2023

Classes	Water	Trees	Crops	Built Area	Range Land	Total	User Accuracy(%)	Producer Accuracy(%)
Water	8	0	1	0	0	9	0.89	0.89
Trees	0	3	0	1	0	4	0.75	1.00

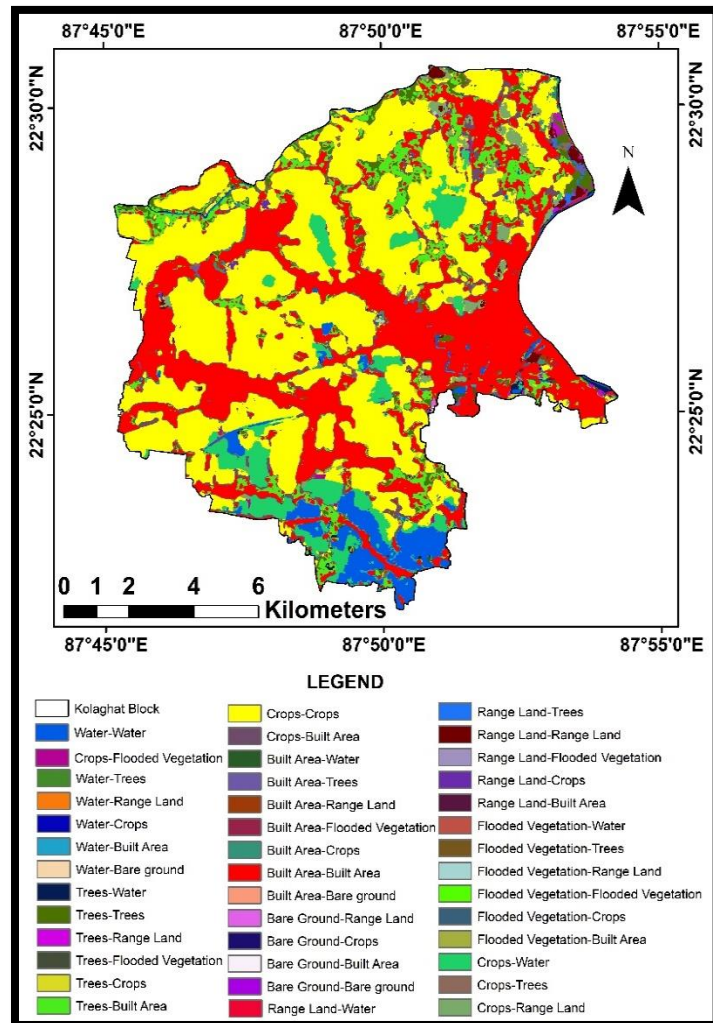
<b>Crops</b>	0	0	42	4	0	46	0.91	0.93
<b>Built Area</b>	0	0	2	36	0	38	0.95	0.86
<b>Range Land</b>	1	0	0	1	1	3	0.33	1.00
<b>Total</b>	9	3	45	42	1	100		
Overall accuracy: 0.90							Kappa accuracy: 0.84	

Table-6 represents Land Use Land Cover transformation from 2017 to 2023. It reveals that great portion of lands converted from Trees to Built area (961.43 hectares), Crops to water (890.48 hectares), Crops to Built area (587.12 hectares), Crops to Range land (224.74 hectares), Built area to crops (100.19 hectares) and Crops to Trees (95.46 hectares) respectively.

**Table-6: Land Use Land Cover Transformation matrix (2017-2023)**

Land Classes		Land Classes 2023( Hectares)							Grand Total
		Bare ground	Built Area	Crops	Flooded Vegetation	Range Land	Trees	Water	
Land Classes 2017(Hectares)	Bare Ground	0.19	0.65	0.32		2.60			3.76
	Built Area	0.06	4420.30	100.19	0.50	34.40	37.67	31.92	4625.03
	Crops		587.12	6197.91	23.98	224.74	95.46	890.48	8019.69
	Flooded vegetation		14.27	10.26	2.49	3.61	1.50	4.03	36.16
	Range Land		14.77	27.70	0.06	76.65	22.40	11.90	153.48
	Trees		961.43	79.59	2.23	33.59	356.24	42.02	1475.10
	Water	0.49	44.55	5.46		8.39	3.31	648.95	711.15
<b>Grand Total</b>		<b>0.74</b>	<b>6043.08</b>	<b>6421.43</b>	<b>29.26</b>	<b>383.97</b>	<b>516.58</b>	<b>1629.30</b>	<b>15024.36</b>

**Figure-5: Land Use Land Cover (LULC) transformation from 2017 to 2023**



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## Conclusion :

For ensuring planned development and monitoring the land utilization patterns, preparation of land use and land cover map is very necessary (Saxena et al. 2008). This is the very interesting study from 2017 to 2023. From the above analysis it is clear that human activities affect a geographical area. Land use in this area is changing every year with urbanization. For example, cultivable land and vegetation are decreasing, but built-up area is increasing. As the number of trees is decreasing, governments and NGOs need to be proactive and cooperative in planting trees. Of course, personal initiative is also important in this case. It is expected to be very useful in formulating meaningful plans and government policies to achieve balanced and sustainable development in the study area.

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