International Journal of Recent Engineering Research and Development (IJRERD)
ISSN: 2455-8761
www.ijrerd.com || Volume 08 – Issue 04 || April 2023 || PP. 01-14

The Nature and Intensity of Land Transformation in two distinct mandals of Urban Rural belt (15-40 kms) of Hyderabad Metropolis

Dr. T. Pratigna,
Asst professor, Department of Geoinformatics, Telangana University

Prof. T. Anuradha
Department of Geography
Osmania University

Abstract: The study area is a part of peripheral areas of city of Hyderabad which is the capital of Telangana state. The study area falls in parts of erstwhile Rangareddy, Mahaboobnagar, Nalgonda, Medak districts of Telangana. Telangana state is one of the youngest state in India formed out of the northwestern part of the joint state of Andhra Pradesh.

Land and its concerns are universal in nature. Land with all its natural attributes very rarely gets unchanged as time progresses. This is inevitable as the land man relations are so intricate and so inter dependant that as the man develops technologically and increases his needs, there is bound to be an alteration in the nature of the land in turn, the land gets transformed. In a way, the natural land cover under unaltered condition switches over to altered land use suiting to the environs. In general, the level of land transformation is directly proportional to the technological advances and increasing human demands on the land. This type of land transformation is more evidenced where there is dwindling land-man ratio, which is more conspicuous in urban and peri urban areas. Land Transformation manifests itself in many ways culminating into fragmentation and complex land breakup.

In this paper an attempt has been made to study the *Nature* and *Intensity* of Land transformation within a specified boundary by using Arc GIS 9.1V software.

Keywords: Land Use, Land Cover, Land Transformation and Urban Rural belt.

Introduction

Land Transformation is the transformation in Land use and Land cover. LULCC is also known as land change (LUL CC by Else Ellis; 18th Apr 2010) is a general term for the human modification of Earth's terrestrial surface, i.e., LULCC is subset of Land Transformation. The term, 'Land Transformation', is built in within the word. Literally it is the transformation of the Land in a Spatio-Temporal context. Transformation Study is the process of identifying differences between the objects or state of any phenomena by observing it at different time periods. Land is in a continuous state of transformation as a result of various natural and manmade process.

It is triggered by a number of driving forces both natural as well as human induced changes–namely, Urban Growth, Increase in Transportation Corridors and other urban infrastructure facilities etc., Land Transformation is imminent in every developing region and

Maximum in regions centering round growing cities, because of ever increasing need for the provision of urban amenities. Rapid urban sprawling is witnessed around major metro cities of the world. In India Mumbai, Delhi, Kolkata, Chennai, Bengaluru and Hyderabad are front ranking cities in terms of their urban expansion.

Drivers of Land Transformation:

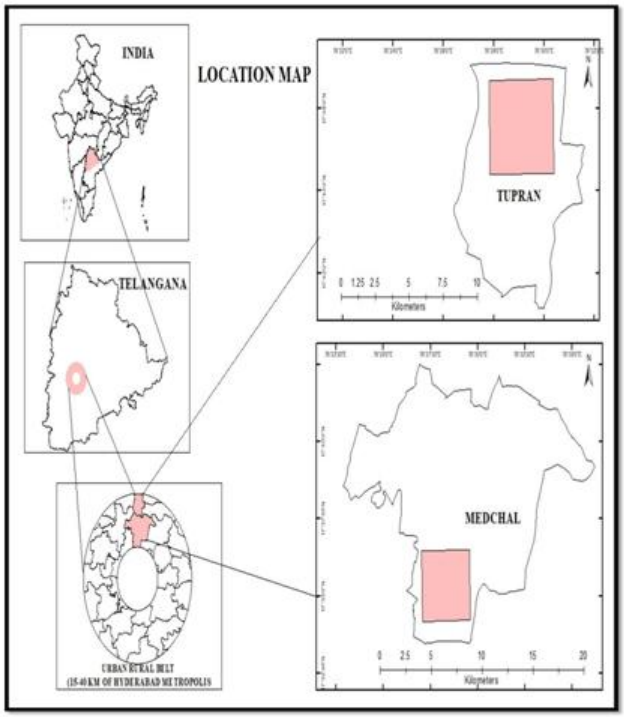
1. Environmental & Physical factors
   Land and Soil degradation, Climatic variability Encroachment to the vegetal canopy other than croplands and the water bodies for the rising demand of Agricultural lands etc.
2. Demographic factors
   Migration, Population Growth, Urbanization and Population Distribution etc.:
3. Socio economic factors
   Variability in production and productability in agricultural lands, real estate which is leading land fragmentation and convert agricultural lands into commercial lands and marginalization of land holdings due to increasing family size and change in occupational status.
4. Other driving forces of land transformation are

- Local culture (food preference, demand for specific products etc.).
- Infrastructural and Institutional Amenities and Finance Services.
- Marketability, Industrial development, Price and Policy etc.
- Availability of Irrigational avenues, Supplies of Agricultural inputs, Knowledge based approaches of the advances in Agricultural activities and business strategies etc.

Study Area:

Two mandals for the study are selected in the urban rural belt(15-40kms) of Hyderabad city. The first area of study is the Medchal Mandal, is located near to the Urban Rural belt (15-40kms),with geographical area of 19.041 km² and it is bounded by 17° 44'27″N 17°46'44″N latitude and 78°27'48"E 78°30' 21"E longitude. The secondarea selected for study is Tupran Mandal, is locted far to Urban Rural belt(15-40kms) with geographical area of 19.041 km² and it is bounded by 17° 34′14″N 17°36′28″N latitude and 78°27'1"E - 78°29' 33"E longitude. The below map shows the area of study.

Map 1:



Objectives

1. To study the land use and land cover of the study area.
2. To identify the Spatio-Temporal Land Transformation of the study area for a period of 25 years (1990-2015).
3. To identify the nature and intensity of the Land Transformation in study area.

Database and Methodology

SOI Toposheets of series 56K5, k6, k9, and K10 were used for generating the base map. LANDSAT 5TM and LANDSAT 8OLI scenes (path 144, row 48), for the years 1990 and 2015 pertaining to the region, are used for the identification of Land Transformation. GIS tools like ArcGIS v10.1 and ERDAS imagine v2013 were used for Land Transformation mapping. MS Excel is used to analyze the statistical data.

After careful examination, a classification (fallow NRSA22 fold classification with little changes) has been adopted which has level I (primary) five classes for both the time periods, They are:

1. Agricultural land
2. Builtup area
3. Forest area
4. Water bodies
5. Other land.

Agricultural Land: This includes crop area of both the seasons of kharif as well as rabi, common area for both seasons has been considered to avoid duplication.

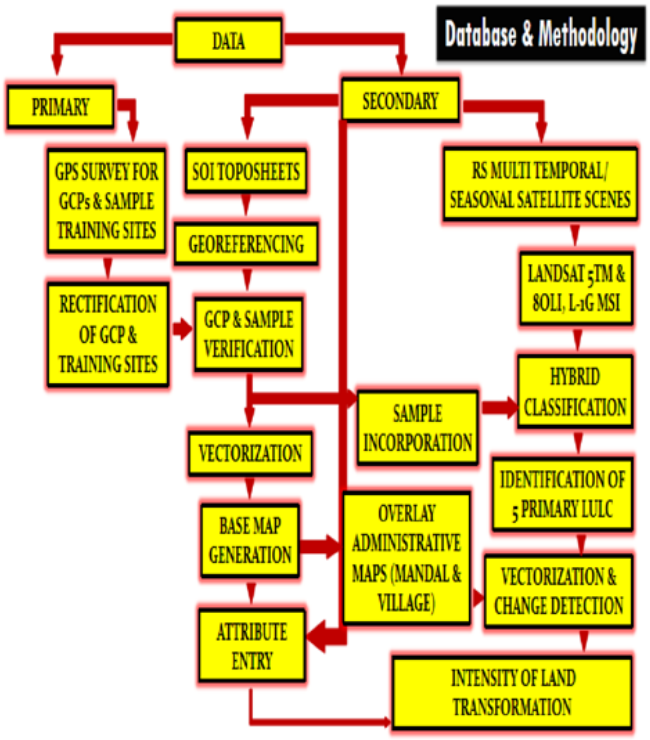
Built-up Area: it includes all types of man made settlements of the urban or rural, urban settlements, Road ways etc are put in under this category.

Forest Area: it includes forest area comprising of all green cover foliage can be private or state owned.

Water bodies: this includes all types of water bodies like rivers, streams, lakes, ponds, etc

Other lands: All the other land including wasteland, Barrenland, rocky area, scrubland, excepting above cited categories put under this categories.

Flow Chart : Graph 1



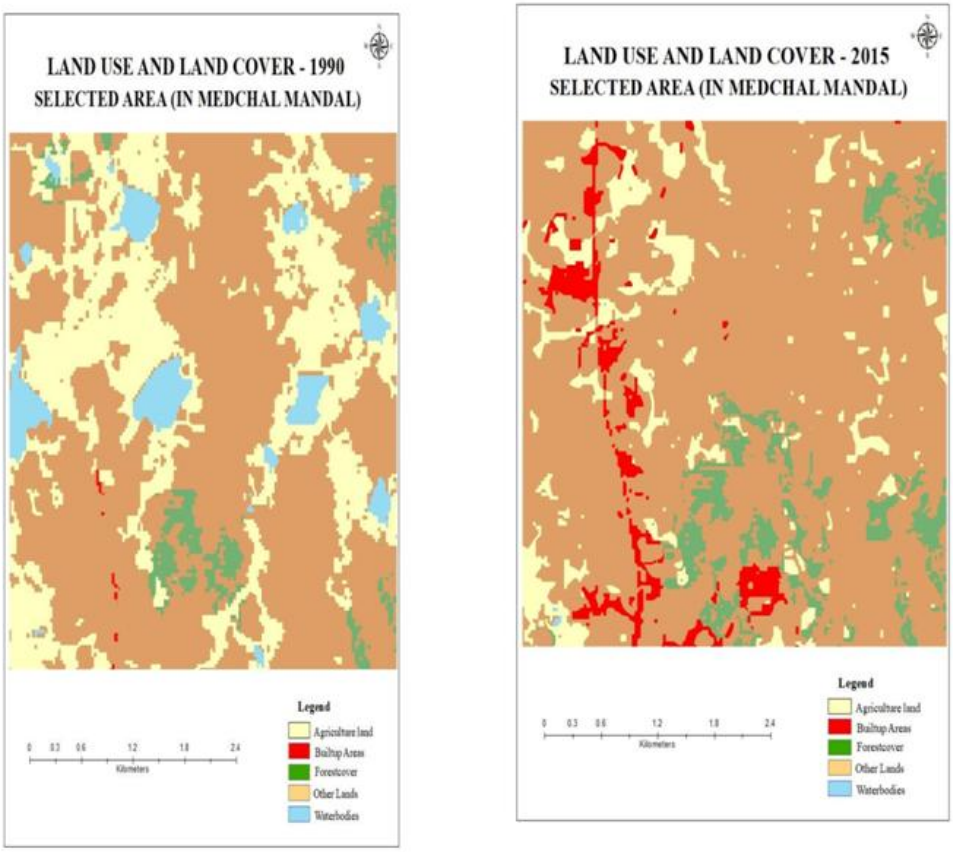
In the current study area, the data has been collected from 2 major sources. i.e primary as well as secondary and secondary data is always verified with primary data field collected in real time from the study area UrbanRural belt (15-40km) of Hyderabad metropolis.

The primary data is collected from GPS. Secondary data is collected from survey of India toposheets of 1:50,000 scale for preparation of base map. Multi seasonal scenes of the land sat 8 (OLI) and land sat 5 thematic map (TM) images were collected from the official United State Geological Survey (USGS) database for the peiod of 1990 and 2015 respectively to prepare the LULC maps. Satellite. Flow chart showing the methodology adopted for land use/ land cover mapping is given in Map 1.

Table 1:
Land Use and Land Cover Change (1990-2015) of Selected Area in Medchal Mandal

Land Cover	1990 (Area in km²)	Percentage	2015 (Area in km²)	Percentage	Change(Area in km²)	% Change of Area in
Agriculture	5.75	30.18	1.841	9.67	-3.909	-20.51
Waterbodies	1.04	5.46	0.008	0.04	-1.032	-5.42
Built up Area	0.02	0.10	0.847	4.45	0.827	4.35
Forest cover	0.66	3.46	1.323	6.95	0.663	3.49
Other lands	11.58	60.79	15.023	78.90	3.443	18.11
TOTAL AREA	19.041	100	19.041	100	-	-

MAP2:Land Use and Land Cover of Selected Area in Medchal Mandal



Land Use and Land Cover of Selected Area in Medchal Mandal

The land use land cover of **Agriculture area** of the selected area of medchal mandal in 1990 has changed from 5.75 sq km to 1.841 sq km in 2015 with change in percentage of 30.18 in1990 to 9.67 percent in 2015, with total change of area of 20.51%. Areal extent of **water bodies** have been reduced from 1.04 sq km in 1990 to 0.008 sq km in 2015, with a change of 5.46% in 1990 to 0.04% in 2015 and a total change of area of 1.032 with a percentage of 5.42%.

The built up area has increased from 0.02 sq km in 1990 to 4.45 sq km from 0.10% in 1990 to 4.45% in 2015 with change in area of 0.827 sq km which makes 4.35%.**The Forest cover area** has increased from 0.66 sq km in 1990 to 1.323 sq km in 2015, with an increase in percentage from 3.46 in 1990 to 6.95 percentage in 2015 with total change of area of forest cover is of 0.663 sq kms with 3.49%.

The Other land use class area has increased from 11.58 sq km in 1990 to 15.023 sq km in 2015, with an increase from 60.79% in 1990 to 78.90 % in 2015 with a total change in area of 3.443 sq kms which makes up 18.11% in change of area (Table 1).

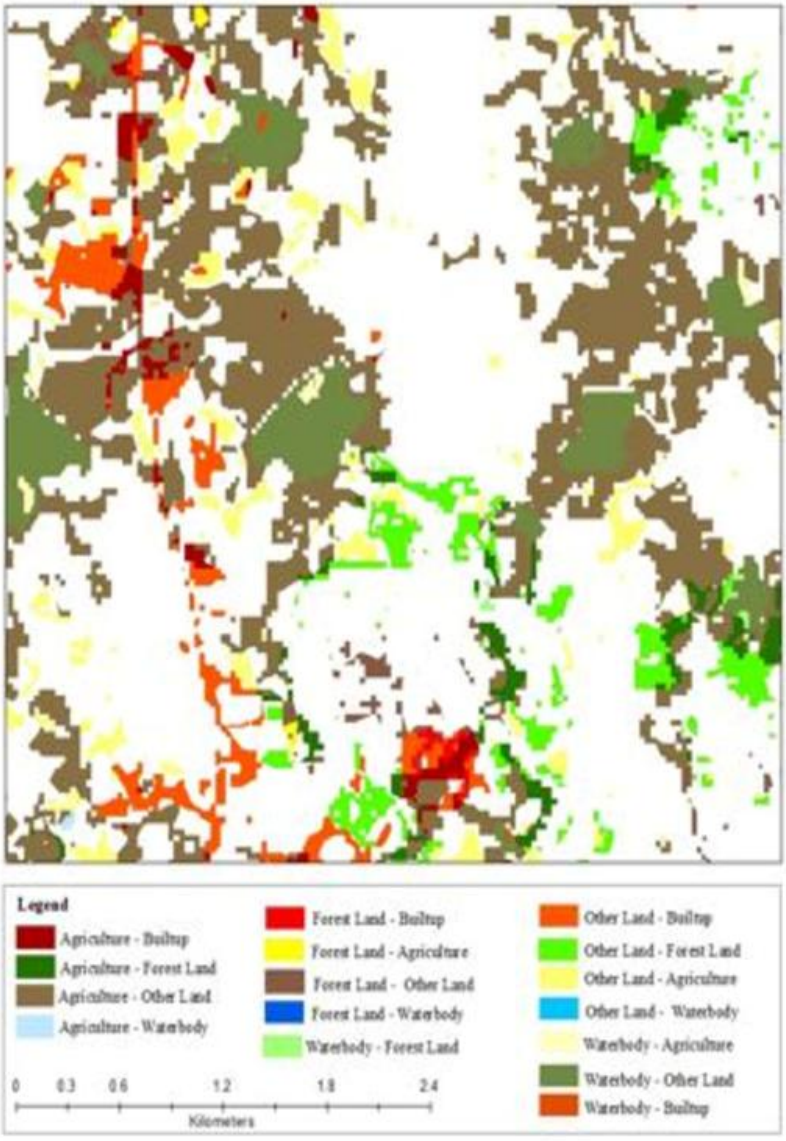
Table 2:

Land transformation of Selected Area in Medchal Mandal (1990-2015)(in sq.km)

LULC Classes	Agriculture	Built up	Forest cover	Waterbodies	Other land	Total Area (2015)	Change
Agriculture	**5.75**	-	0.0175	0.0494	0.6399	1.841	-3.909
Built-up	0.2131	**0.02**	0.0333	0.0072	0.5764	0.847	0.827
Forest	0.2922	-	**0.66**	0.0130	0.5650	1.323	0.663
Waterbodies	0.0060	-	-	**1.04**	-	0.008	-1.032
Otherland	4.1062	-	0.1536	0.9652	**11.58**	15.023	3.443

1. Figures diagonally in bold area under particular land use/cover class in 1990.
2. Figures in the rows of the land use/cover class are addition to that class during 1990-2015.
3. Figure in the columns of the land use/cover class are transformation (subtraction) from that class during 1990-2015.

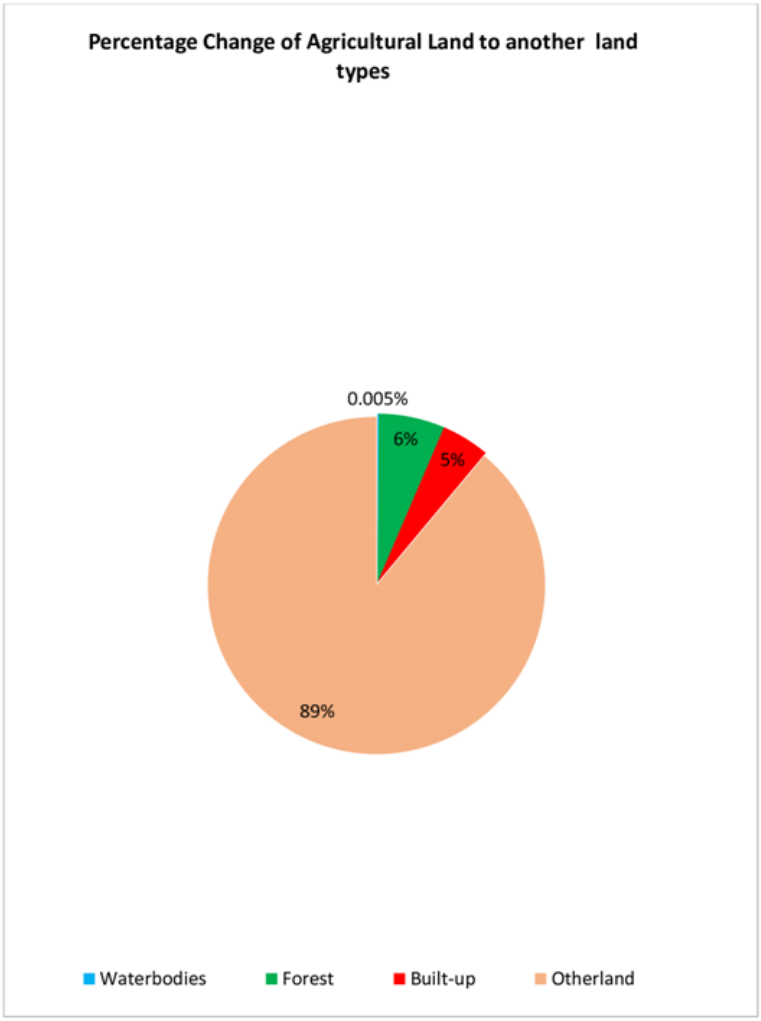
MAP3:Land transformation of Selected Area in Medchal Mandal (1990-2015) (in sq.km)



Transformation of Agriculture Land (1990-2015):

Out of total area of Medchal mandal the total agricultural area was 5.75 sq kms in 1990 which has decreased to 1.841 sq kms in 2015. Out of the total Agriculture area 0.2131Sq kms (5%) was converted to Built up area, (0.2922 Sq kms-6%) into Forest land, 0.0060 sq kms (0.005%) into Water bodies, 4.1062 sq kms (89%) into Other lands. At the same time the Agriculture area has gained 0.0175sq kms from Forest cover, 0.0494sq kms from Water bodies, 0.6399 from Other lands(Table2)(MAP3& GRAPH 2).

Graph 2:



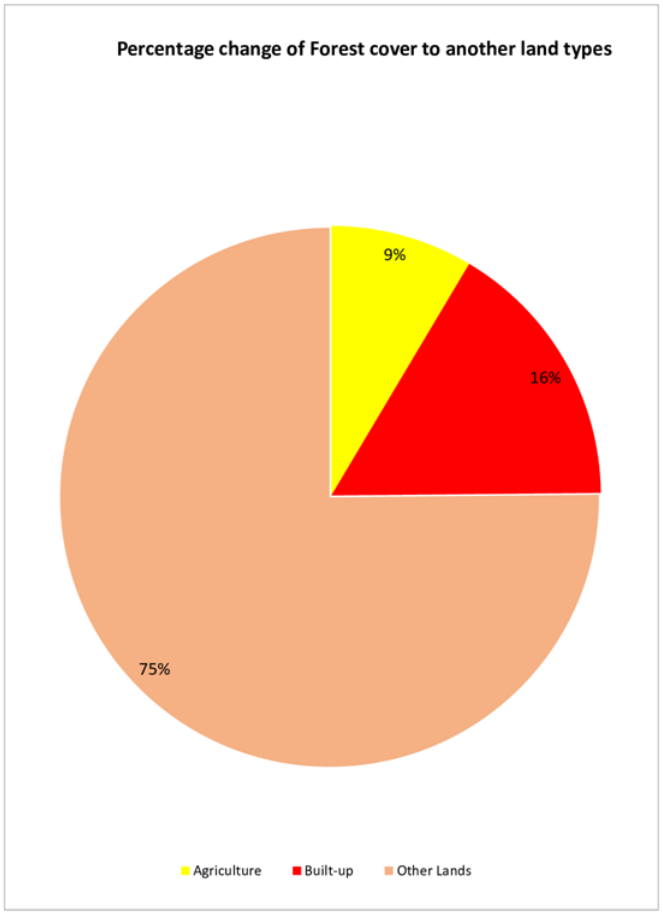
Transformation of Built up area (1990-2015):

In the Medchal mandal the total Built up area of 00.02 sq kms in 1990 has increased to 0.847 sq km. It has gained 0.0333sq kms from Forest cover, 0.0072 sq.kms from Water bodies, 0.5764 sq kms from other land (Table2) (MAP3).

Transformation of Forest Land (1990-2015):

In the Medchal mandal forest land was spread in 0.66 sq kms in 1990 which has declined to 1.323 sq kms in 2015. 0.0333 sqkms(16%) of its area was converted into Built up, 0.0175sqkms(9%) into Agriculture land, 0.1536 sq kms(75%) into Otherland area,. At the same time it has gained 0, 2922 sq kms from Agriculture land, 0.0130 sq kms from Water bodies, and 0.5650 sq kms from Other land. (Table2) (MAP3 & GRAPH 3).

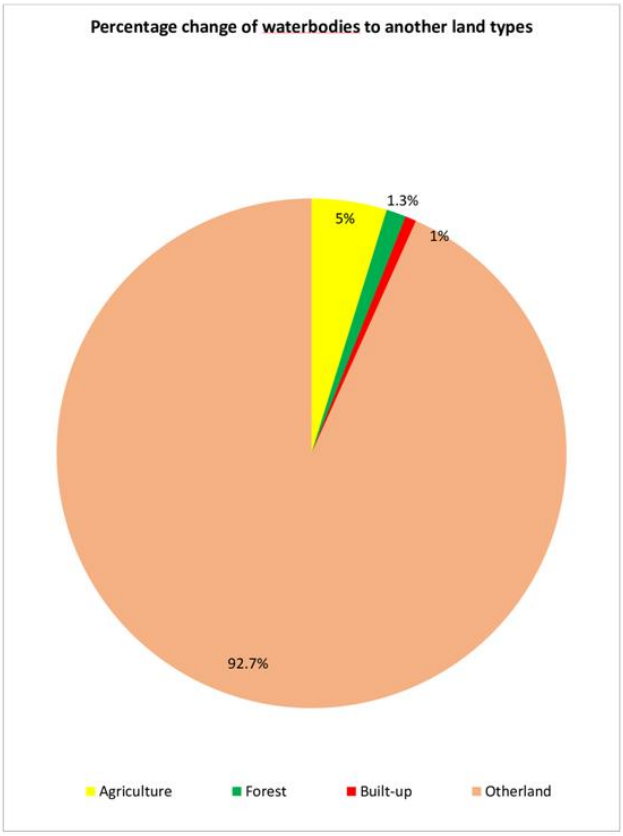
Graph 3:



Transformation of Water body (1990-2015):

In the Medchal mandal total Water bodies were spread over 1.04 sq kms in 1990 it has decreased to 0.008 sq kms in 2015. Among the total area of water bodies 0.0494 sq km (5%) was converted into Agicultural land, 0.0072 sq kms (1%) into Built up land, 0.0130 sq kms (1.3%) into Forests Cover, 0.9652sq km (92.7%) into Other land. At the same time it has gained 4.1065sq kms from Agriculture, 0.1536 sq kms from Forest cover, and 0.020 sq kms from Other land (Table2)(MAP3 & GRAPH4)).

Graph 4:



Transformation of Otherland(1990-2015):

In the Medchal mandal total area of Other land were spread over 11.58 sq kms in 1990 out of it, 0.6399 sq kms (36%)was converted into Agriculture land, 0.5764 sq kms(32%) into Built up area, 0.5650 sq kms (32%) into Forest land , over time it has gained 4.1062 sq kms from Agriculture, 0.1536 sq kms from Forest cover, 0.9652 from Water bobies, on the whole it has increased to 15.023 sq kms by 2015(Table2)(MAP3 & GRAPH5).

Graph 5:

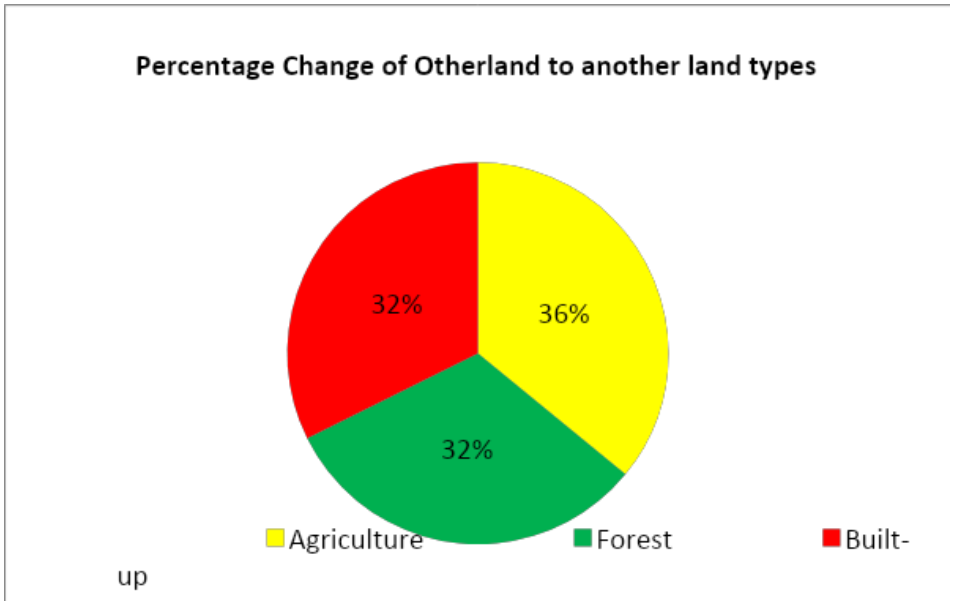
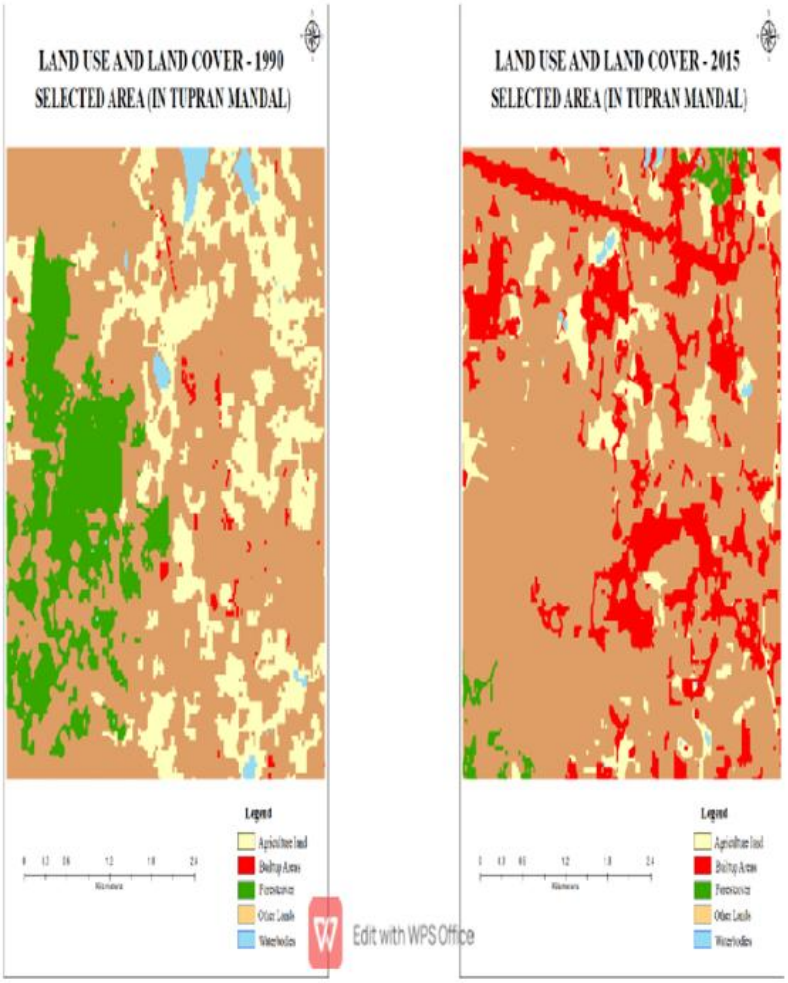


Table3:
Land Use and Land Cover Change (1990-2015) of Selected Area in Tupran Mandal

Land Cover	1990 (Area in km²)	Percentage	2015 (Area in km²)	Percentage	Change(Area in km²)	% Change of Area in
Agriculture	3.992	20.96	1.480	7.77	-2.512	-13.19
Waterbodies	0.263	1.38	0.075	0.40	-0.188	-0.98
Built up Area	0.160	0.84	3.539	18.59	3.379	17.75
Forestcover	2.897	15.21	0.261	1.37	-2.636	-13.84
Otherlands	11.730	61.60	13.686	71.87	1.956	10.27
TOTAL AREA	19.041	100	19.041	100	0	0

MAP 4



Land Use and Land Cover Change (1990-2015) of Selected Area in Tupran Mandal

The Land use Land cover of **Agriculture area** of the selected area of Tupran mandal in 1990 has changed from 3.992 sq km to 1.480 sq km in 2015 with change in percentage of 20.96 in 1990 to 7.77 percent in 2015, with total change of area of 2.512sq km i.e., 13.19%.

The Water bodies have been reduced from 0.263 sq km in 1990 to 0.075 sq km in 2015, with change of 1.38% in 1990 to 0.40 % in 2015 and a total change of area of 0.188 with a percentage of 0.98.

The Built up area has increased from 0.160 sq km in 1990 to 3.539 sq km i.e., from 0.84% in 1990 to 18.59% in 2015 with change in area of 3.379 sq km which makes 17.75%.

The Forest cover has decreased from 2.897 sq km in 1990 to 0.261 sq km in 2015, with an decrease in percentage from 15.21 in 1990 to 1.37 percentage in 2015 with total change of area of Forest cover of 2.636 sq kms with 13.84%

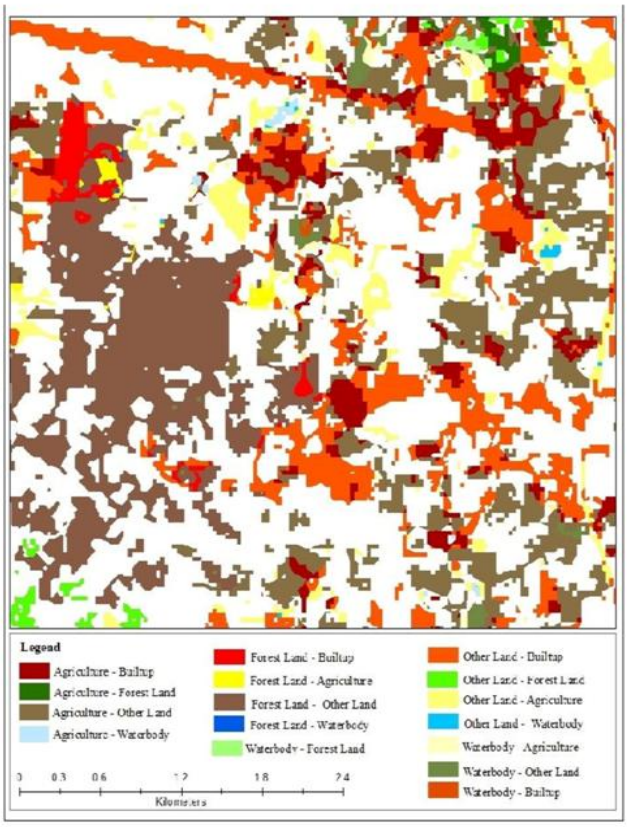
The Other land use class have increased from 11.730 sq km in 1990 to 13.686 sq km in 2015, with an increase from 61.60% in 1990 to 71.87 % in 2015 with a total change in area of 1.956 sq kms which makes up 10.27% in change of area.

Table 4:
Land transformation of Selected Area in Tupran Mandal (1990-2015) (Area in sq.km)

LULC Classes	Agriculture	Built up	Forest cover	Waterbodies	Other land	Total Area (2015)	Change
Agriculture	**3.992**		0.057	0.042	0.752	1.480	-2.512
Built-up	0.872	**0.160**	0.224	0.040	2.244	3.539	-0.188
Forest	0.078		**2.897**	0.019	0.118	0.261	3.379
Waterbodies	0.029		0.003	**0.263**	0.020	0.075	-2.636
Otherland	2.383		2.568	0.138	**11.730**	13.686	1.956

- Figures diagonally in bold area under particular land use/cover class in 1990.
- Figures in the rows of the land use/cover class are addition to that class during 1990-2015.
- Figure in the columns of the land use/cover class are transformation (subtraction) from that class during 1990-2015.

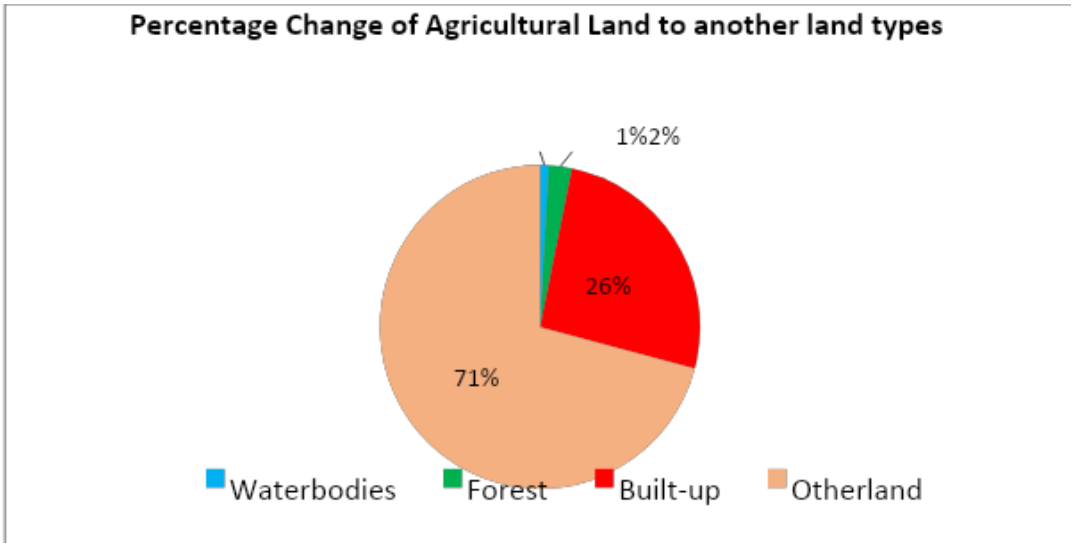
MAP5:Land transformation of Selected Area in Tupran Mandal (1990-2015)(in sq.km)



Transformation of Agriculture land (1990-2015):

Out of total selected area of Tupran mandal the total Agricultural area was 3.992 sq kms in 1990 which has decreased to 1.480 sq kms in 2015. Out of the total Agriculture area 0.0872 sq kms(26%) was converted to Built up area, 0.078sq kms (2%) into Forest Cover, 0.029 sq kms(1%) into waterbodies, 2.383 sq kms(71%) into otherlands. At the same time the Agriculture area has gained 0.057sq kms from Forest cover, 0.042sq kms from Waterbodies, 0.752 from Otherlands (Table4, MAP 5 & GRAPH6).

Graph 6:



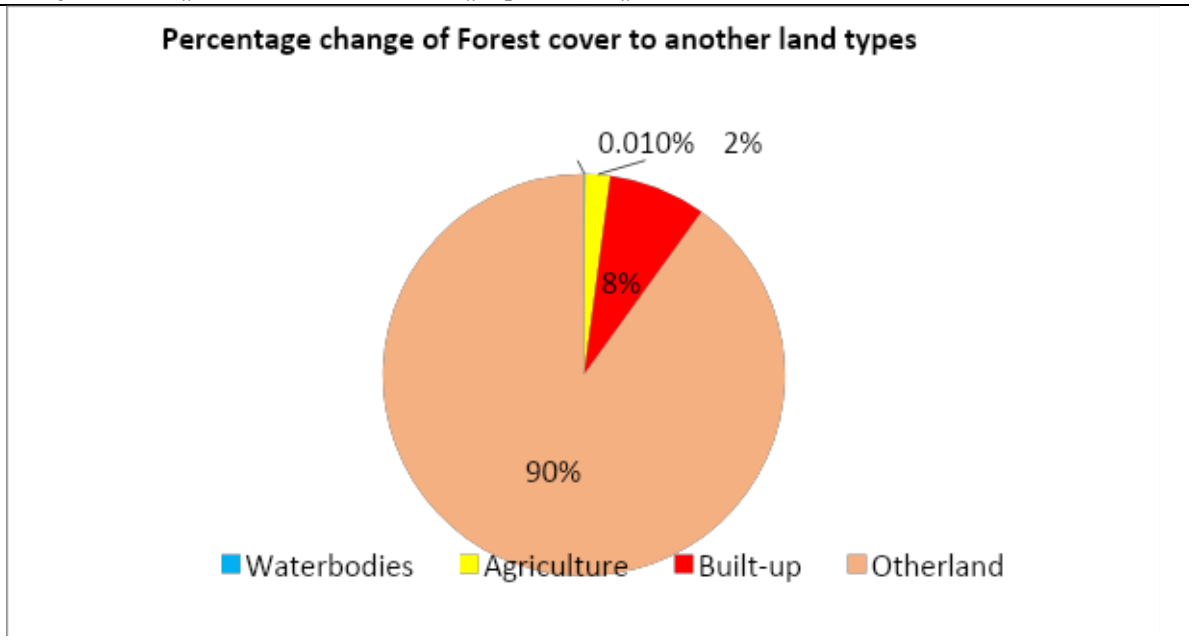
Transformation of Built up area (1990-2015):

In the selected area of Tupran mandal the total Built up area of 0.160 sq kms in 1990 has increased to 3.539sqkms. It has gained 0.224sq kms from Forest cover, 0.040 sq kms from Water bodies, 2.244 sq kms from Other land(Table 4 &MAP 5).

Transformation of Forest cover (1990-2015):

In the selected area of Tupran mandal Forest cover was spread in 2.897 sq kms in 1990 which has declined to 0.261 sq kms in 2015. Out of total land under forest in 1990, 0.057 sqkms (2%) into Agriculture land, 0.224 sq kms(8%) into Built up area,0.003 sq kms(0.010%) into Water bodies, 2.568 sqkms (90%) into Other land. At the same time it has gained 0.078 sq kms from Agriculture land, 0.019 sq kms from Water bodies, and 0.0118 sq kms from Other land. Meanwhile the 0.078 sq kms has remained intact from 1990(Table4, MAP5 & GRAPH7).

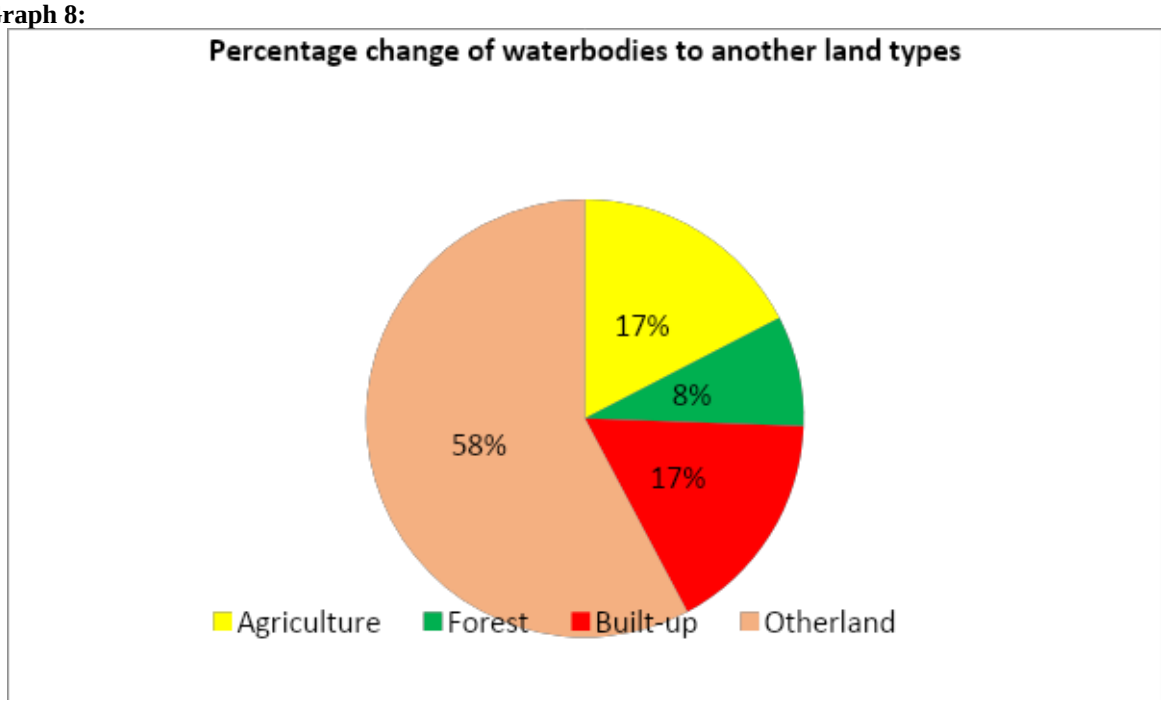
Graph 7:



Transformation of Water bodies (1990-2015):

In the selected area of Tupran mandal total Water bodies were spread over 0.263sq kms in 1990 it has decreased to 0.075 sq kms in 2015. Among the total area of Water bodies 0.042 sq km (17%) was converted into Agicultural land, 0.040 sq kms (17%) into Built up land, 0.019 sq kms(8%) into Forestcover, 0.138 sq kms(58%) into Otherland use class. At the same time it has gained 0.029 sq kms from Agriculture land, 0.003 sq kms from Forest cover, and 0.020 sq kms from Othe rland use class (Table4, MAP 5 & GRAPH8).

Graph 8:



Transformation of other land (1990-2015):

In the selected area of Tupran mandal total area of Othe rland use class was spread over 11.730 sq kms in 1990 out of it 0.752 sq kms (24%)was converted into Agriculture land, 2.244 sq kms (71%) into Built up area, 0.118 sq kms (4%) into Forest Cover, 0.020 sq kms(1%) into Water bodies over time it has gained 2.383 sq kms from Agriculture land, 2.568 sq kms from Forest cover, 0.138 from Other land use class , on the whole it has increased to 13.68Sq.kms

Graph 9:

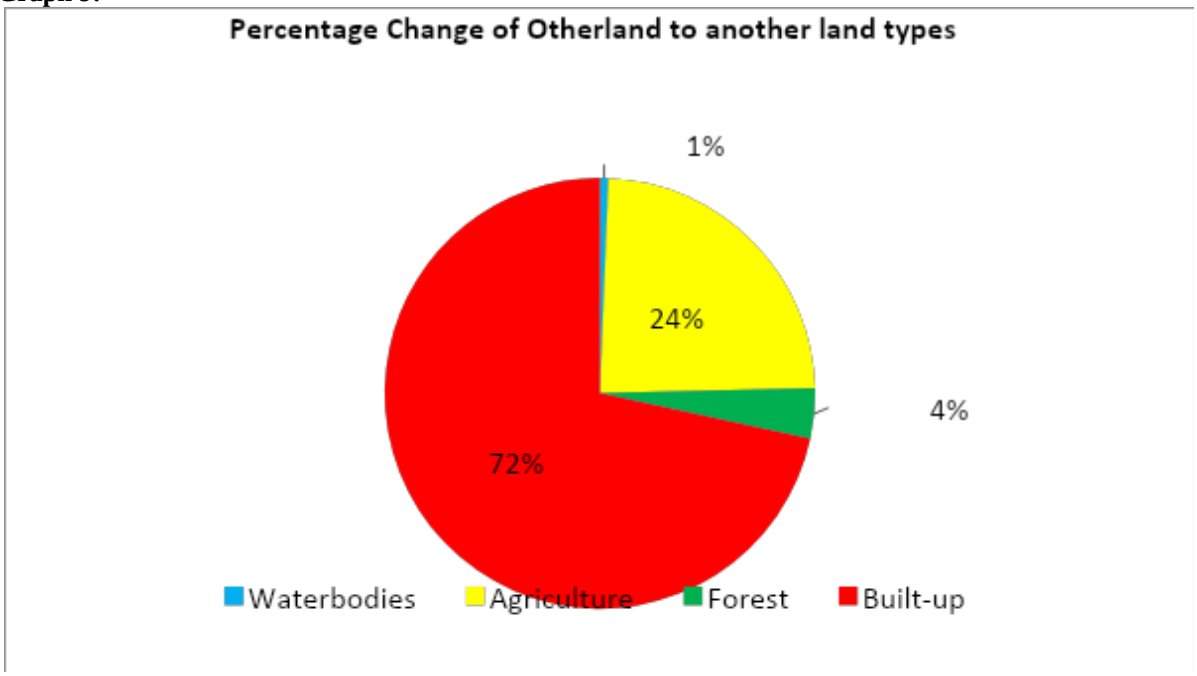


Table 5: Intensity of Land Transformation (1990-2015)

	Medchal Mandal (19.041 area in KM)			Tupran Mandal (19.041 area in KM)		
Land Cover	Percentage 1990	Percentage 2015	% Change of Area	Percentage 1990	Percentage 2015	% Change of Area
Agriculture	30.18	9.67	-20.51	20.96	7.77	-13.19
Waterbodies	5.46	0.04	-5.42	1.38	0.40	-0.98
Built up Area	0.10	4.45	4.35	0.84	18.59	17.75
Forest cover	3.46	6.95	3.49	15.21	1.37	-13.84
Other lands	60.79	78.90	18.11	61.60	71.87	10.27
TOTAL AREA	100	100	-	100	100	0

Conclusion:

- As selected area of Medchal mandal is near to the Urban Rural belt (15 to 40 kms), Percentage of change of Agriculture land , water bodies and other land use class , is more in selected area of Medchal mandal than the percentage of change of Agriculture land , water bodies and other land use class in selected area of Tupran mandal.
- In general change of intensity of Built-up area in selected area of Medchal mandal should be witnessed more as it is near to the Urban Rural belt (15-40kms) but in contradiction to this, percentage of change of Built-up Area is 4 times greater in selected area of Tupran mandal than the percentage of change of Built-up area in selected area of Medchal mandal. It means when an individual is moving from center of the city to the outskirts, the intensity of the change in Built up area is more due to developmental activities initiated.
- Percentage of Forest cover area has increased by 3.5% in selected area of Medchal Mandal has showna positive sign due to initiatives taken by the government through the urban forestry and social forestry programmes and other schemes where in percentage of Forest cover area is decreased to 14% in selected area of Tupran mandal though it is far away from the city.

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