



**RESEARCH PAPER**

**Distinctive Analysis of Land Cover Change Exposure of Karachi through Multi-Temporal Remotely Sensed Imageries**

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**ABSTRACT**

Pakistan's Sindh province is home to Karachi. Thus, the project is based on the changes in Karachi's land cover as seen by satellite imagery. The city contains a significant amount of open space as well as streams and estuaries, while having the highest density of population. All of the things that I have to keep an eye on, such as settlements, vegetation, the road system, agricultural regions, bare soil, coastal areas, barren areas, etc., can be clearly distinguished using satellite imagery from Landsat TM 30m in the years 2000, 2003, and 2014. Techniques from GIS and remote sensing are applied. Unsupervised classification has been carried out in all images. The work's outcome demonstrates a sharp increase in Karachi's built-up area between all of the aforementioned years, as well as a shift in the city's open spaces and decreased vegetation.

**Keywords:** Change Detection, Land Cover, Remote Sensing

**Introduction**

Research has indicated that the number of landscapes that are preserved in their original state on Earth is quite few. The Earth's surface is being significantly changed by human activity; also, human habitation and land use have had a profound impact on the ecosystem, leading to a discernible arrangement of terrestrial usage and coverage of features across the phases of different times.

Change of land cover uses are significant factors in the research and analysis of the modern global environment. Damage of agrarian land, cut of trees, losses of biodiversity, universal heating up, an escalation in natural disasters, also overflowing of water are all major effects of land use and loss of biodiversity (LULC) brought on by human activity and natural alterations. (Mas, et al 2004, Zhao, et al 2004, Dwivedi et al 2005).

The way that natural and socioeconomic variables are used by way of human being throughout factor of timing which determines the pattern of terrestrial usage and covering in a given area. Due to intense pressure from agriculture and population growth, terrestrial zone is a suitable rare source. In order for fulfill the growing demand for fundamental social necessities as well as wellbeing ways, also facts about land utility and land coverage of features as well as opportunities meant for their greatest potential utility is crucial for the assortment, design, also carrying out of terrestrial usage programs. This data also helps with tracking the dynamics of land usage brought on by shifting population demands.

Variations in the utility of terrestrial cover have taken center stage in modern approaches to monitoring environmental shifts and managing natural resources. An exact assessment of the distribution as well as condition of the global forests, grasslands, and agronomic wealth takes turn into a major concern due to expansion of the idea of flora representing through maps, which takes substantially increased exploration on land use and land cover change. Remote Sensing and GIS are now enabling new ways of managing ecosystems. Remote sensing allows for synoptic analyses of Earth-system functions,

patterns, and changes over time on the basis of Locally, regionally, and globally balance. Satellite imagery data also serves as a bridge between detailed, local ecological research and the conservation, management, and management of biodiversity at a regional, national, and international level (Wilkie and Finn, 1996).

These geoenvironmental issues are often associated with Land use Land Cover fluctuations. So existing information on landuse and landcover change able to offer the serious information for the coice creating process which related to environmental managing along future ecological arrangement (Fan et al 2007, Prenzel, 2004). Growing social and commercial demands on a rising population will ultimately affect terrestrial usage and land covering features. This burden leads to unintended and abandoned fluctuations in landuse and landcover (Seto, 2002).

Terrestrial usage and land-living representing in forms of maps which are important piece wherever within another factors remain unified for the necessity base to initiative many growing catalogue for terrestrial plus aquatic resources. Usage of land states that human actions as well as the diverse usages those remain accepted above land living process along covering of any land area which bring up towards the naturally growing plant life, aquatic forms, rocky and loam, false shelter as well as other elements observed on terrestrial zone Prakasam, 2010).

In the domain of policy and expansion the usage of land cover which is very significant factor in change of exploration. Catalogue as well as observing the variations in any land living areas and its usage are obligatory features for more knowledge for modification method also showing the influence of variation over the environs also related ecologies on diverse measures which stands to be exactly essential for surrounding (Chen, 2003).

### **Literature Review**

The land-living and terrestrial covering arrangement of an expanse stands as a result of nature related plus socially and economical aspects also its use by means of human in historical period of given time. Land-living system is a suitable rare source in line for the huge farming plus demographical weight. Therefore, facts for utility of land and terrestrial shelter plus options to the best usage which is important in assortment, arrangement also for carrying out in land-living practices which outlines for run into the collective weight for prime necessities of social based as well as for wellbeing. Though this data similarly backings into observing the changing aspects on the basis of terrestrial usage resultant on view of varying burdens for the growing populations in areas. (Opeyemi, 2006).

Terrestrial usage plus land covering variation develop a dominant factor for present plans in supervision of sources which are naturally distributed on earth also observing ecological fluctuations. While expansion into the notion of agricultural maps significantly better in exploration related to land utility plus terrestrial modification as a result it provide a precise assessment earth covered features on land surface. Observing the Earth's from exosphere today is important for understand the impact of human actions for his nature related sources based in excess of phase in time period. So into the circumstances of fast in addition to frequently not verified terrestrial modification, interpretations on ground by exosphere offer detached evidences of anthropological consumption on the basis of land sites. Above the historical ages, records through the ground detecting digital form turn into dynamic landforms in maps on the Earth as well as structures of features, and handling the nature related sources along reviewing the ecological variation. (Opeyemi, 2006).

Nowadays, remote sensing and Geographical Information Systems (GIS) stands dominant technological tool toward develop precise in addition to well-timed data for the spatial dispersal of land-living information and usage of land change above big expanses

worldwide. Historical plus current revisions directed through system of government as well as associations all over the place from sphere, generally, it focused over the use in variation of land living and also usage of land by means of RS plus GIS. GIS offers smooth background used for gathering, storage, exposing as well as evaluating ordinal facts which required to reviewing the changes. Remote sensing data is very significant information base which utilized for GIS also in correlated tools. Digital images are utilized for the credit of synoptically facts of earth exterior (Shirazi, 2012).

Karachi is the most populous and commercial center of Sindh province with an area of 3,527 km<sup>2</sup> and a population of 11,969,284 (2006 estimate). The city is located at 24° 51' 36" N and 67° 00' 36" E, eastern side covered coastal line of Arabian Sea, just north and western side there is mouth of the Indus. As land of this metropolitan consists mostly on plane or gently sloping plains by scattered urban areas on the two sides of westerly and northerly borders. Dual watercourses passes over the city area one is Malir river (starting northeast to the center) then Lyari river (starting the northern to the southern parts). Many other smaller rivers also run through the city, and the general drainage is from the eastern and northern areas to the south. Karachi has an arid climate, but as a coastal city, it experiences low temperatures and little rainfall except during the monsoon season. (DCR, 1998).

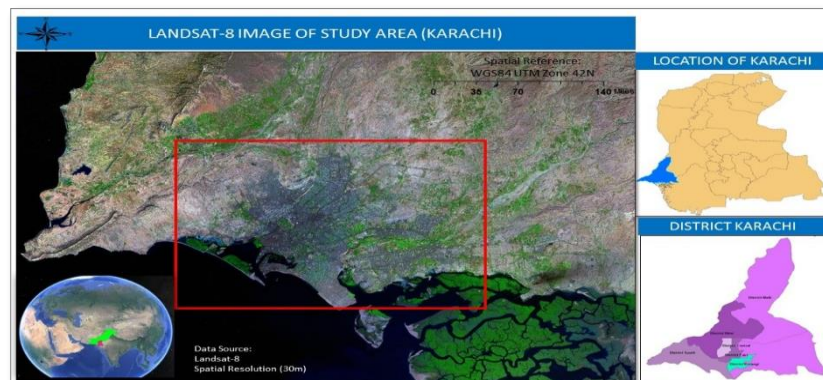


Fig: 1 Study Area (District Karachi)

Landscape of the study area can be generally distributed in dual fragments the mountainous parts towards the northern as well as western also the plains plus region connected to coast to south eastern part of Karachi. Though Karachi Hilly areas are successors of Kirthar Hills. Though the uppermost point of these peaks in city stands approximately 528 meters which are the risky towards northern part. Entirely these hills remain barren from plants also these are interspersed with extensive plain, arid riverbeds along river passages. Karachi takes a lengthy seashore line to the southern side. Well-known coasts included Hawks Bay, Paradise Point, Sands Pit and Clifton. China Creek and Korangi Creek offer exceptional quiet waterways meant for paddling plus another marine activity occur. Far from the coast there are smallest islands like Shamsh Pir, Baba Bhit, Bunker, Salehabad and Manora.

The city has a moderate weather temperature and relative humidity is relatively high, ranging about 58% in December (as dried up month) upto 85% in August (as wet month). The cooler light wind in late afternoon which is an excessive helpful for the residents. Karachi receives southwesterly winds for more than half of the year, including monsoons. The wind turns east and northeast in winter, keeping the average temperature around 21 degrees.

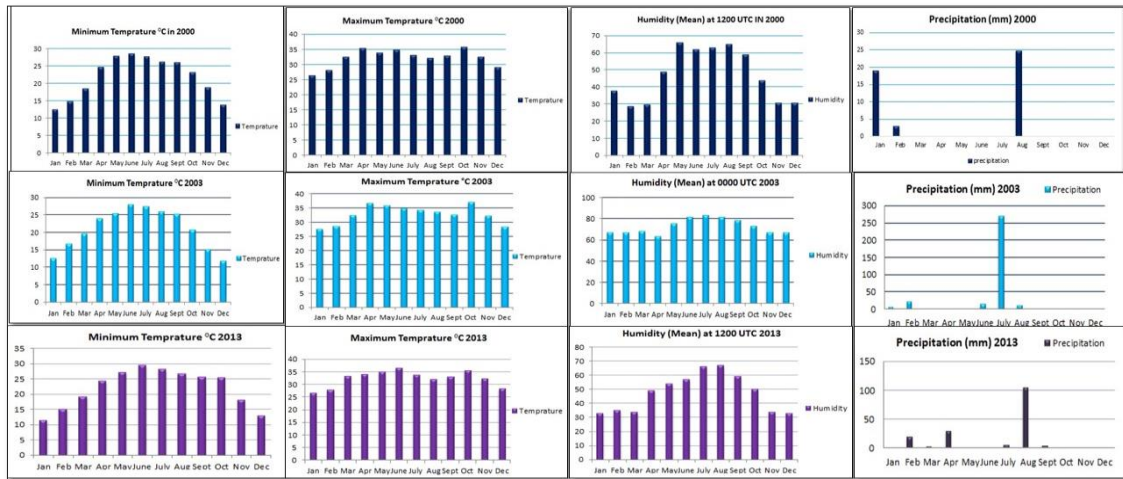


Fig: 2 Climate History of Study Area (District Karachi) 2000,2003,2013

May and June warmest months , while the average hotness of degree is 35 degrees. January is coolest month in all the moths of year. In the course of rainy period of July plus August, nearly every day is cloudy and the amount of precipitation is usually low. Though, there are unexpected differences from year. The yearly usual precipitation is 256 mm, on the other hand the certain years have higher rain plus heavy rainfall can fall in a little time of 48-hour period.

According to the 1998 census, Karachi had five districts according to the replacement district of 2000, 2003, but according to the new administrative structure, Karachi has six districts, so in 1998, the densely populated area was known locally as East Karachi. Like Karachiites, made up of racial language clusters across the country and Southern Immigrants from Asia, making the metropolitan and its inhabitants a various melting pot. the residents rate of the karachi remained approximately 105,000 in 19<sup>th</sup> century and it gradually grew during the following periods, getting more than 400,000 people on time of freedom. Though inhabitants rate was estimated at 15 to 18 million, of which about 90 percent remained immigrants since various background. While Karachi and its population are projected to grow around 5% annually (mostly through rural and intra-city movement), with projected 45,000 migratory workers who arrive in the karachi each month since diverse zones of the country.

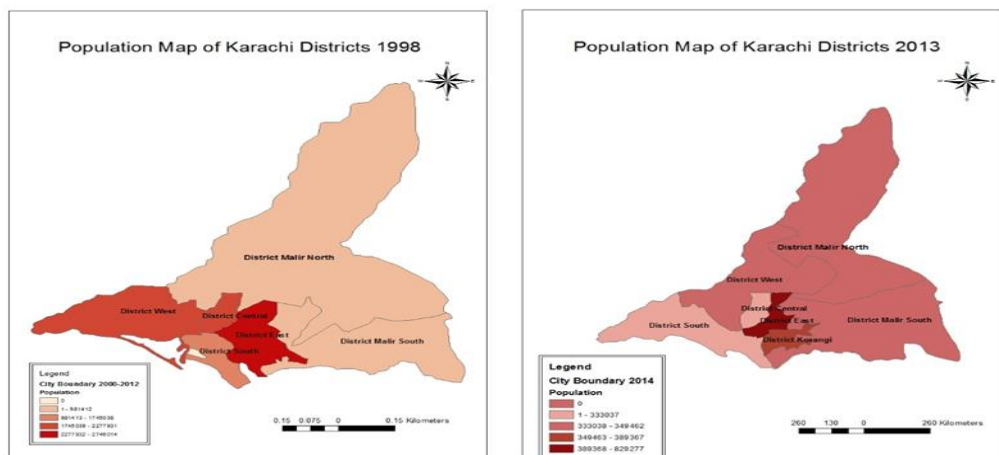


Fig: 3 Population of Study Area (District Karachi) 1998,2013

Karachi is the heart of Pakistan, it is a metropolitan city, therefore growing plus development doings like construction, built of highways and several further anthropological

actions have led to increased consumption of land also fluctuations in utility of land and change in terrestrial coverage. over time. Satellite data plus GIS) to calculate that condition as its change overall period for the way to identify the rate of cultivation. Therefore, it is necessary to carry out such a study if Karachi wants to avoid the problems associated with emerging and growing cities like many others in the world.

### Material and Methods

Methodology is the right strategy to complete the research and find the way to achieve the goals and fulfill the requirements. Planetary expertise, geographic information systems (GIS) and remote sensing (RS) take previously have wide use in land cover zones like natural resource detecting in addition to managing, cultivation, rustic plus urban development. Intended for the revision, Landsat imageries of Karachi were obtained for three years; 2000, 2003 and 2014. The management map was also prepared using ArcMap 10.8 software. The georeference properties of all images taken with the Earthgoogle placeholder took the X and Y coordinates of the images and set the values to the same locations in the other images.

One of the most common applications of remotely sensed imagery in livestock production is the design of diagrams of terrestrial covers, flora types, and another characteristic categories using satellite data softwares. In unsupervised cataloging, image handing out softwares categorizes the images base which founded on the naturally groups of the spectral characteristics of the picture element deprived of the handler identifying in what way to organize each part of imageries. Theoretically, unsupervised cataloging is parallel to group exploration, wherever interpretations remain dispersed towards similar category as they take parallel values. The handler obligation to define the key facts, like spectral groups for useage as well as in what manner numerous classes have to utilize for cataloging, or softwares can produce each digit of class built only on naturally collected groups. Unsupervised ordering produces a productivity imageries in which multiple categories are detected also every picture element is given category.

Multi- chronological digital records usual detected through LandSAT 7 plus 8, Thematic Mapper (TM), LandSAT. Resolution is 30m. Digitally observed terrestrial usage and covering areas on land the cataloguing done through supervised ordering technique, created over the basis of subject understanding which working for performing the grouping of feature classes. ArcGIS 10.8 stands a potent tool to take out the land living usage cover, from Karachi map also LandSAT image of study area. The terrestrial usage land-living covering classes included agricultural plot, open spaces, built-up (residential, roads), aquatic bodies to show up in study area. The grouping of classes are done based through the classify order (Prakasam, 2010).

**Table 1**  
**Data Source of Satellite Imageries**

S.No	Data Type	Year	Resolution	Source
1	Landsat image	2000	30m	USGS
2	Landsat image	2003	30m	USGS
3	Landsat image	2014	30m	USGS

These categories might be or parheps not match up sound to the land-living covering sorts of attention, besides the handler must define expressive tags for every category. Unsupervised cataloging usually marks in excessively several land-living covering categories, especially for diverse terrestrial covering varieties, plus categories usually want to stay joined to produce a significant diagram. In another circumstances, the cataloging can results in a diagram which chains several land-living coverage categories of attention, in addition to the category need to divided in the several categories in the last layout.

**Table 2**  
**Land cover classification scheme**

<b>CODE</b>	<b>LAND USE/LAND COVER CATEGORIES</b>
1	Vegetation
2	Open land
3	Built-up land
4	Roads
5	Water bodies

The developed classification system gives a fairly broad classification, where cultivation of land is indicated by the number one. As description in open terrestrial use for this study means the areas covered in dust, hilly regions plus another desert land caused by human activities.

### **Change Detection**

Variation finding explorations includes an extensive variety for different procedures utilizing for identification, define as well as measure the variances among imageries for few sights on not the same time or else underneath the altered situations several means are able for use individually or else in grouping otherwise use in mixture as per portion of a variation revealing investigation. Modification exposure set of choices afterward a straightforward method for determining the variations among a couple of imageries they signify a couple of imageries which present the primary phase as well as ending phase. The modification exposure data of classified imageries regular use of the calculate the maps for change in imageries. (Manonmani, 2010).

Remote sensing facts, expediently handled plus expanded, might be truly valuable for modification uncovering task for display the changes on land cover on altered timings. So, initial beginning over defined datasets of time-based multi classify ordered imageries, the method of digitally variation findings development remained permitted for determination as well as to define alterations on land cover among three important break of time 2000, 2003 and 2014. At hand there are various techniques of modification exposure presented also for each take differences reliant on the image nature, concluding resolution of the picture modification as well as the sort of variation to sensed. In this revision at this point defined, the approach charted that is "classified Image assessment" As this method permits for conclude the change amongst individually categorized imageries by each times in query then this is the solitary technique that content "starting" and "towards" class groups are able to planned to each altered picture element. (Fichera, 2012). The way propose the help for permit the formation plus bring up-to-date of GIS data stores, such as classes/groups remain specified, also numerical value of every group can be located and identified. Together by way of "classified Image assessment" a GIS method remained joined, near the capably fit in land cover mapping method also in numerical expose the modification changing aspects class wise. As benefit of GIS procedures it is not simply interrelated toward the manipulation of data store abilities, on the other hand as well for capability towards the bring about diverse land cover diagrams by way of sources of different distinctive raster hand for the demand to simply calculate the sum for changes.

This way, linking the land cover facts, which permitted to sort rightly accessible the tabulated form data which covering the Geo-spatial data for every group of classes also the data around quantity, locality, plus natural modification. Hereafter, matching every classified maps within the continuous record, that remained probable to the conclude change on land cover in diverse an inordinate length of time since 2000, 2003 and 2014. Though evaluation of alteration in classes examined the specified values in Table 3, wherever described the related digits, grouped for all classes. As those numeric (in hectares)

described beside the diagonal direct the extent which are not altered in land cover forms on the another column comprise the quantity in way of percentage of the areas. (Fichera, 2012).

**Results and Discussion**

The numbers given in the table for the area of every land-living covering class in for each year. Made in 2000 is the lowest category, only 12.5% and the same as in 2003, but the change in 2014 is about 15.4% in the high population area and about 17.9% in the medium-sized land of the study area Vegetation cover was 3.2% in 2000 and decreased to 2.5% in 2003 due to population growth, but increases again to approximately 3.3% in 2014 due to roadside plantations in Karachi.

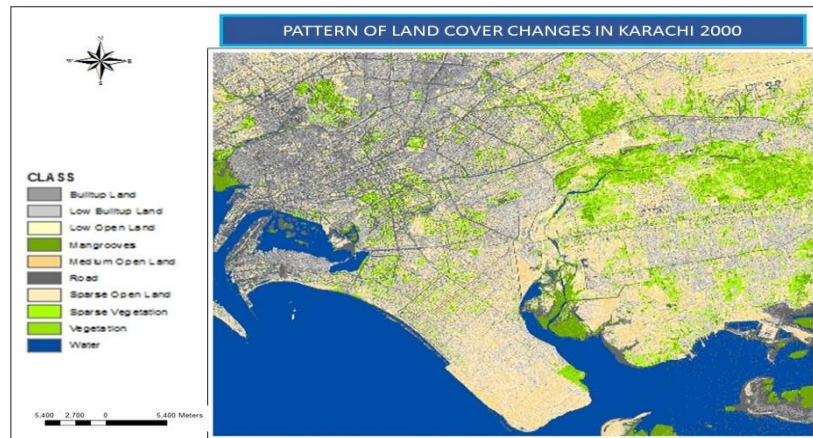


Fig: 4 Land cover of Study Area (District Karachi) 2000

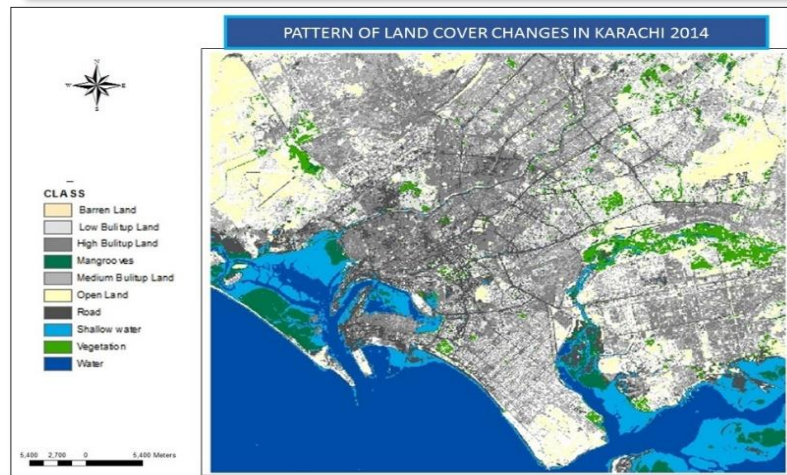
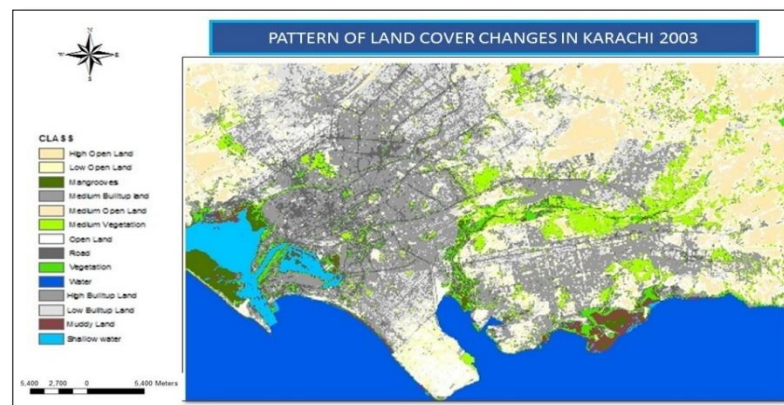


Fig: 5, 6 Land cover of Study Area (District Karachi) 2014

**Table 3**  
**Land Cover Distribution (2000, 2003, and 2014)**

S.No	Land Cover Categories	Area (ha) 2000	Area (%) 2000	Area (ha) 2003	Area (%) 2003	Area (ha) 2014	Area (%) 2014
1	Water	489167	24.6	210557	29.4	149829	19
2	Vegetation	60207	3.2	18247	2.5	25587	3.3
3	M.Veg:/Sparse veg:/Sh. water	131729	6.6	51912	7.2	48974	6.4
4	Mangroves	54781	2.7	9436	1.3	16601	2.3
5	H.Bulitup land	248984	12.5	90664	12.5	117279	15.4
6	M.Bulitup land	299705	15.4	122461	17.1	136431	17.9
7	H.Open land	255861	12.8	32957	4.5	54993	7.4
8	M.Open land/L. bulitup land	160301	8.0	56432	7.8	64427	8.4
9	L.Open land/ other bulitup lan	69295	3.4	82435	11.4	99142	13.6
10	Road	215090	10.8	44738	6.3	47197	6.3
<b>Tota</b>		<b>198512</b>	<b>100</b>	<b>719839</b>	<b>100</b>	<b>760460</b>	<b>100</b>

Significant fluctuations in landcover in Karachi remained perceived in Karachi over a period of 15 years. Such as it can be seen in Table 3 and Figures 4, 5 and 6, the use of the construction industry increased from 2000 to 2014, as shown in Table 3. As a result, as extent of plants with vegetative also not built up plot reduced. The state is worrying, for the reason that when land use increases in cities, several related problems appear. As the plea for accommodation also another facilities of residents is growing everyday. This affects the insubstantial economy of the region.

Change in agglomeration during the study period, the same growth was observed in central agglomerations and large agglomerations of Karachi. In the same way, the percentage reduction of the growth cover is much faster compared to the built-up area. Vegetation has decreased due to the growth rate of the urban city. The general change in this land use during the study period (2000-2014) is striking.

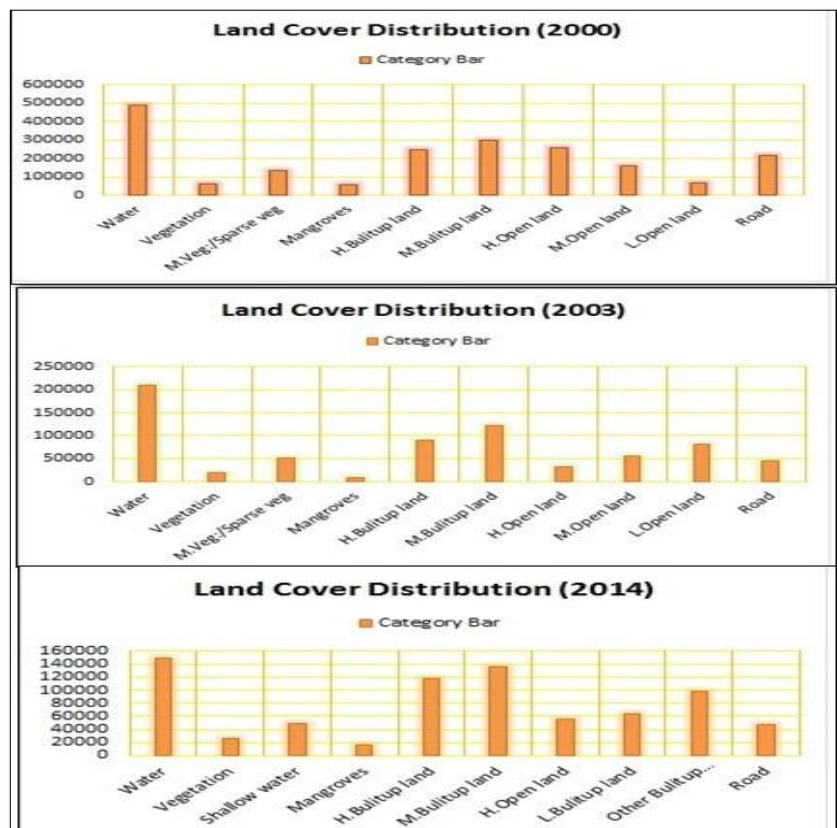


Fig: 7 Land cover of Study Area (District Karachi) 2014



In addition, several environmental problems were observed around the city as many waste areas were observed around Liyar, Sohra bigots and many other areas of Karachi, which is the main reason for land clearance.

This condition has a negative impact in the area due to urbanization, environmental problems, traffic problems, lack of social services, crime and related social problems. As the population thus increasing creates more problems and the city becomes more congested with the growth rate, as the population increases, the problems of human origin increase. Therefore, it is proposed to encourage Karachiites to build new residential areas on the outskirts by providing incentives and attractions in the city center.

Karachi city is the commercial center of Sindh province where different communities have settled not only from the country but people who have migrated from other countries live here in Karachi for different purposes like economic, educational aspect and many have settled for work etc.

### **Conclusion**

This exploration validates the capability of GIS and satellite data facts to collect spatial in addition to temporal records. Different land cover classes have been tried to be recorded as accurately as possible, as they have changed over time. These classes were created separately in every academic year, however by way of a greater importance on constructed-land-dwelling, because this class consists of a combination of anthropogenic activities; and indeed it is the one that affects other classes, and an attempt has also been made to establish a formula for estimating the growth of the population. Though, the results of study displays the speedy progress of constructed-land-dwelling, in 2000, 2003 and 2014. An important aspect in identifying changes is to find out what actually changes what, ie. which land use class changes to another. These data show both desired and unwanted fluctuations besides categories those remain "comparatively" constant eventually. These facts is moreover an important tool for managerial decision-making.

### **Recommoations**

Land use and land cover studies have very significant role in the planning and management of any geographical area world around, Which have a fundamental part to develop any plan or stragety in different fields for development. The study area Karachi is a big city of Pakistan in all perspective, the population is increase day by day due to the mobility of people from all over the world. By the help of different satellite imageries of three years the findings come to the conclusion that the land use and land cover of Karachi distributes in different classes like settlement, road network, water bodies, vegetation and open spaces. The values in all clases have been change due to the increase and decrease in natural and cultural objects. The built-up area remained high in all study years due to high rate of population and vegetation decreased due to the urban sprawl. The planning of city must be desined for the future development and keep safe from the environmental issues generated by anthropogenic activites, manage pure water facility for drinking and plant the trees along roads of Karachi as it can be helpful to keep environment fresh and opne spaces can be utilized for different parks etc. The city must be manage by the city manager as he can over control in city with the help of investors. And the Sindh government must involve to buit new socities and over fly for manage the traffic issues inside the city and encourage the foreign investment for planning and development in future.

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