An Insight to the Decadal Land Use Land Cover Changes of Dakshina Kannada District

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Abstract: ***The Urbanisation has led to the rapid Land Use and Land Cover Changes (LULC) wherein, they are the most important indicators of changes in the ecosystem services. The LULC of an area reflects the pattern of human land use and plays a vital role in space soil and water conservation. The present study involves the statistical analysis to check the decadal dynamics in LC changes using LULC data for Dakshina Kannada district. The study also aims to spot the lost water bodies from the district. For the study most of the data is used from Bhuvan Indian Geo - platform of ISRO for the years 2005 - 2006, 2011 - 2012, 2015 - 2016. Totally 19 LULC classes were studied for the Dakshina Kannada district whose total geographical area is 4843 Sq. Km. QGIS an open source software, was used to extract the maps of the study area and map layouts were prepared. From the available data the study concludes that there is a typical increasing trend in the builtup urban, builtup mining and builtup rural with the rest of the LULC classes showing a decreasing trend. However, an unusual trend has been observed in the classes like forest, scrubforest, grass/grazing, barren/ unculturable/ waste lands and sandy areas. The developmental activities which took place in the past decade as the population of Dakshina Kannada district increased from 18, 97, 730 in 2001 to 2, 089, 649 in 2011 could be one of the reason for the sudden changes in the trends of LULC classes.***

Keywords: Land Use and Land Cover Changes, Dakshina Kannada, QGIS

1. Introduction

The study of land surface change is Land Use and Cover Change (LULC). Land use (such as agriculture, pasture, or plantation) describes human use of land, while land cover (such as forest or desert) describes the biophysical characteristics of the land surface. Land use change may affect land cover, while changing land cover may similarly affect land use. Use of land resources by the people gives rise to land use which varies with the purposes it serves, whether they be food production, provision of shelter, recreation, extraction and processing of materials, and the bio - physical characteristics of land itself. Hence, land use is being shaped under the influence of two broad sets of forces – human needs and environmental features and processes. The terms land use and land cover are not synonymous and the literature draws attention to their use and land cover change. Land cover is the biophysical state of the earth’s surface differences so that they are used properly in studies of land and immediate subsurface. It describes the physical state of the land surface like crop land, mountains or forests (Meyer, 1995 in Moser, 1996). Land cover deals with the quantity and type of surface vegetation, water, and earth materials (Meyer and Turner, 1994). i. e. man made constructions (buildings etc), the type of material used in housing structure (Parveen, 2017). The term land cover originally referred to the type of vegetation that covered the land surface, but has broadened subsequently to include other aspects of the physical environment. The understanding of LULC changes has become the global agenda of the twenty first century as it has a major climate change. The once simple problem of land cover changes has turned complex as Scientists have realized that the these processes largely influence the climate. The land cover (sea plants) in the oceans also have a major role to play in reducing the effects of Tsunamis, it has been proved in a decade long research after the hit of 2004Tsunami. The research in the mid 1970s, recognized that LC changes modify the surface albedo resulting in surface atmosphere energy exchanges, greatly influencing the regional climate. The other broader impacts of LULC changes on the ecosystem, goods and services has also been further identified. Of all the impacts found the one done on biotic diversity world wide is alarming (Sala etal.2000).

The changing paradigm of urbanization has led human populations to transform land use from terrestrial biosphere into anthropogenic biomes. These transformations has evolved a whole new ecological pattern and process for more than 8000 years (Ellis, 2011). Over the past decades several researchers have shown interest in issues related to LULC changes from regional to local level depending on the problem of their interest. Haque and Basak 2016, carried out a land cover change on Tangoar Haur and found that over a period of 30 years 40% of the land cover has been changed predominantly by the anthropogenic activities. They also found that the nearly 71% of the deep water bodies have changed to shallow water bodies. Jat et al., 2017 carried out the assessment of urban growth and prediction of using RS, GIS and Sleuth model for a heterogenous urban area. The study found that economic development and increase in population caused rapid changes of LULC as a result of urbanization & industrialization. They tested the SLEUTH model for heterogeneous growth and found that the model gave satisfactory results however, their application for small unit size development was not successful. Anchan et. al.2018 studied the dynamics of LULC changes. Their study of the Uttara Kannada district showed that the Northern and central zone has experienced drastic increase in built up area decreasing the forests and the southern zone has slow rate of LULC changes. Bello et al., 2018 studied the impact of LULC on Eleyele reservoir for a period of 32 years using Markov - Based Model and found that the reserved forest zone degraded due to the encroachment in the reservoir; and also found that the depth of the reservoir has reduced. Ganasri and Dwarakish (2015) studied the LU/LC dynamics for Harangi Catchment of Karnataka through classification algorithms and found that the forest area and water body decreased dramatically with a increasing trend in plantation and water logged areas main cause being urbanization and agricultural activities. Ochuka et al., 2019 assessed the LULC in Lake Baringo Catchment for the data of 1988 - 2018 and found that increased population growth, poor farming practices, overstocking, charcoal burning urbanization, industrialization and tourism where the Major driving forces of LULC Changes in the area. This intensified the pressure on the land, altered land cover in the catchment area resulting in excess erosion, sediment transport to the lake and subsequently leading to lake pollution, with the increased flood occurrence. They also spotted a significant decrease in the available water bodies in the study area. The SPOT image was used for selecting the satellite imagery for the years 1988, 1998, 2008 and2018. ENVI 5.3 i. e., Environment for Visualizing Images was used for image analysis and the subsequent classification.

Among the several techniques available for LU/LC detection the remote sensing and GIS techniques are extensively used (Nemani and Running, 1997; Zhan et al., 2002; Mallick et al., 2008; Dewan and Yamaguchi, 2009a, b; Mamun et al., 2013; Wang et al., 2009; Ganasri, B. P. and Dwarakish, 2015)

The project is an attempt to examine detect, evaluate and analyze land use land cover changes through ten years in Dakshina Kannada district. The results are expected to show the increase in urbanization and reduction in the agriculture and lands used for agriculture& also regarding the residential area and public buildings. There is a large impact of Land Use/ Land Cover Change on Biodiversity because of Conversion, degradation and fragmentation which is a threat to the integrity of ecosystems land use/ land cover changes in the study area over the past 10 years. To identify the lost water bodies and to identify the main causes behind the changes. Quantum GIS (QGIS) is an Open Source Geographic Information System is also used here to draw the map.

2. Materials and methods

The base map of the study area prepared by using satellite imageries from Bhuvan Indian geo - platform of ISRO has been taken for the study. The results of this study would be helpful to plan and implement important management decisions. From the Bhuvan platform import the map to QGIS and download the shape file for the study area i. e. Dakshina Kannada district. Merge the two files and clip the required area map. Using the print layout option save the maps for the year 2005 - 2006, 2011 - 2012, 2015 - 2016. The statistical analysis of the data obtained for different feature classes are performed. Finally the pictorial representation of the data is done and the conclusions are arrived.

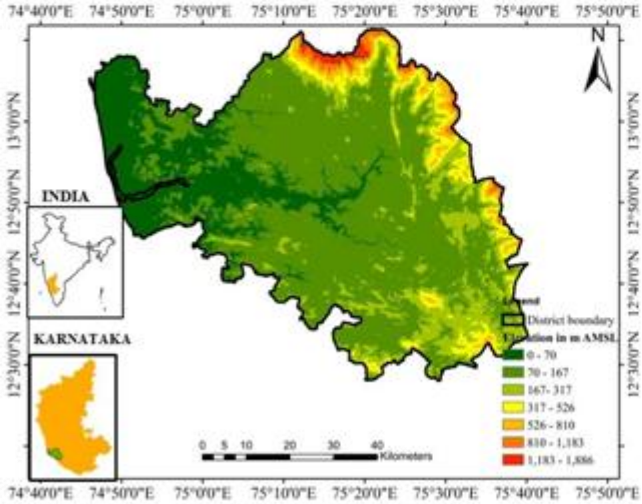


Figure 1: Location of study area

Dakshina Kannada, is a coastal district in the state of Karnataka in India as in Fig 1. Sheltered by the soaring Western Ghats on the east and bordered by the blue waters of the Arabian Sea on the west, Dakshina Kannada district is blessed with abundant rainfall, fertile soil and lush vegetation. Pristine beaches, picturesque mountain ranges, temple towns and a rich culture make it a sought after tourist destination. It is bordered by Udupi District to the north, Chikkamagaluru district to the northeast, Hassan District to the east, Kodagu to the southeast, and Kasaragod District in Kerala to the south. Mangalore is theheadquarters and chief city of the district. Dakshina Kannada district has an area 4, 866square kilometres, and a population density of 430 persons per square kilometre. The region has a total population of 20, 89, 649 (Census of India, 2011). The Latitude and longitude of Dakshina Kannada districtis13°00'0.00"N75°24'0.00" E.

3. Results and discussions

The Dakshina Kannda region has undergone various land use changes since1980s. In this study, land use changes of Dakshina Kannda region has been assessed from 2005to 2015byusingmaps from Bhuvan platform.

Table I: Comparison of the LULC classes for 2005 - 2006, 2011 - 2012, 2015 - 2016

LULC Class	Area (Sq. Km)	Area (Sq. Km)	Area (Sq. Km)
Builtup, Urban	62.7	102.08	162.42
Builtup, Mining	0.03	1.89	6.41
Agriculture, Plantation	1939.63	1946.57	1883.97
Forest, Evergreen/Semi evergreen	1107.71	1084.61	894.28
Forest, Forest Plantation	32.78	57.89	48.72
Forest, Swamp/Mangroves	3.57	0.13	0.17
Barren/unculturable/ Wastelands, Scrubland	109.51	110.46	83.68
Barren/unculturable/ Wastelands, Barrenrocky	43	31.73	15.6
Wetlands/ Water Bodies, Coastal Wetland	1.22	5.73	4.95
Wetlands/Water Bodies, Reservoir/ Lakes/ponds	1.27	1.53	8.48
Builtup, Rural	9.77	215.56	222.12
Agriculture, Cropland	234.28	190.35	202.19
Agriculture, Fallow	12.63	8.89	6.86
Forest, Deciduous	1084.57	897.9	892.07
Forest, Scrub Forest	30.29	23.07	260.19
Grass/Grazing	61.95	58.27	50.86
Barren/unculturable/ Wastelands, Sandarea	0.28	2.38	1.54
Wetlands/Water Bodies, Inland Wetland	6	3.04	2.53
Wetlands/ Waterbodies, River/Stream/canals	101.82	100.92	95.97

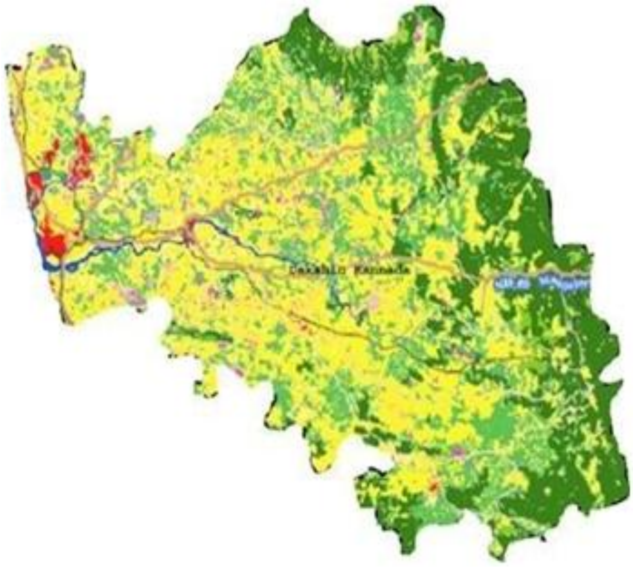


Figure 2 (a): Land use Land cover map for the year2005 – 2006

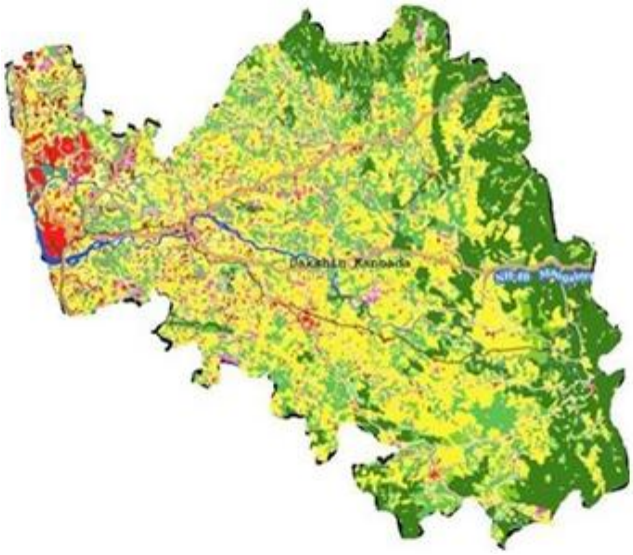


Figure 2 (b): Land use Land cover map for the year 2011 - 2012

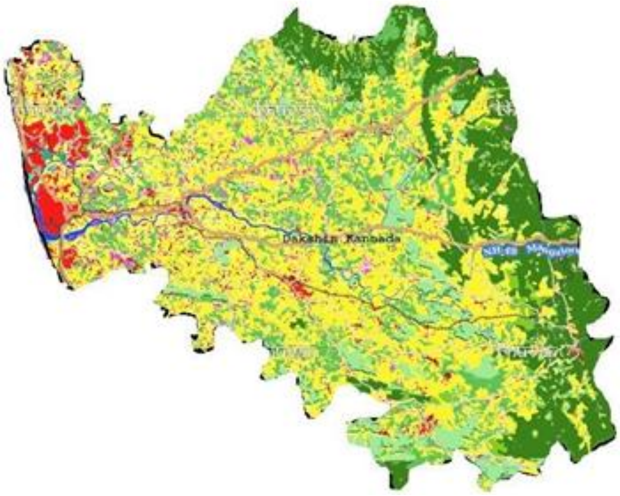
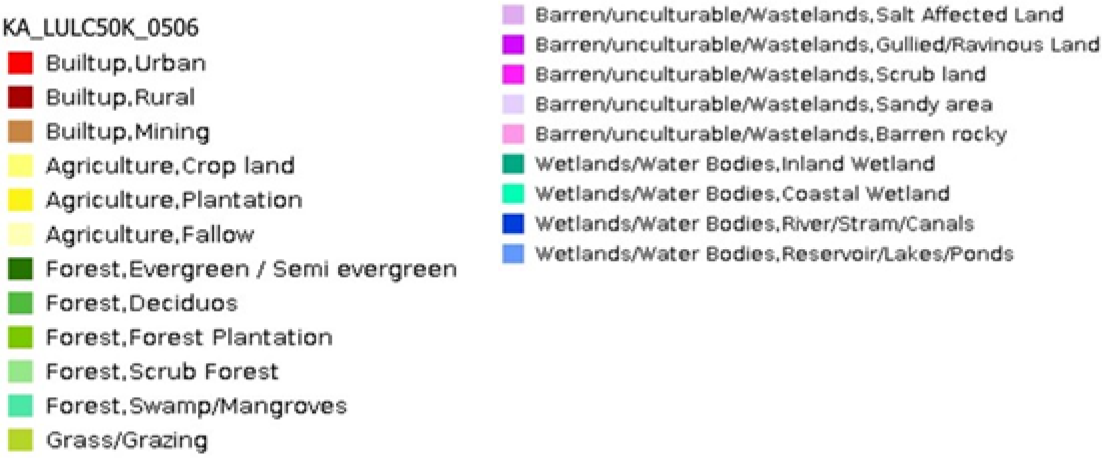
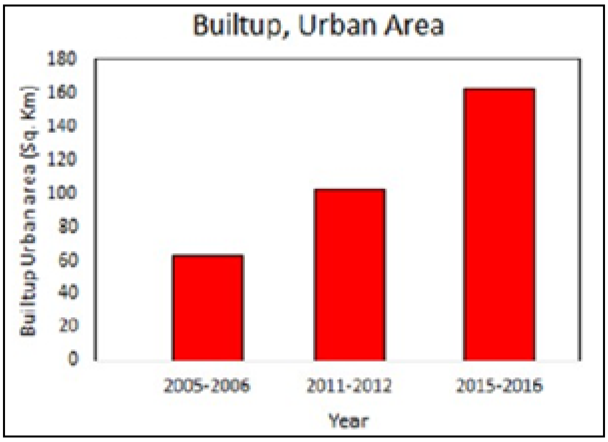
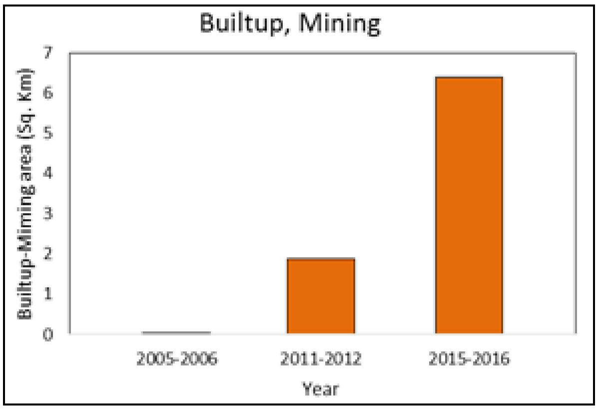


Figure 2 (c): Land use Land cover map for the year 2015 - 2016

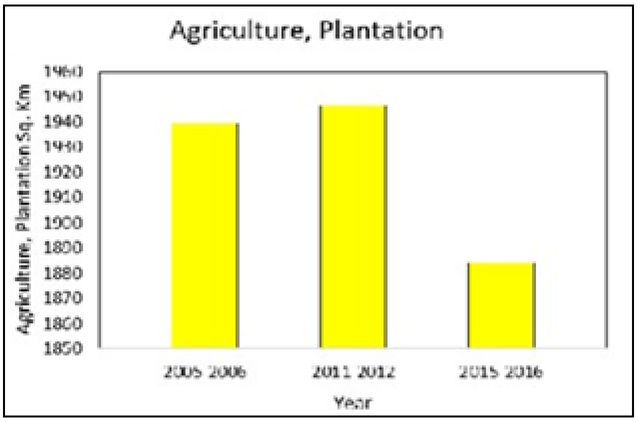




(a)



(b)



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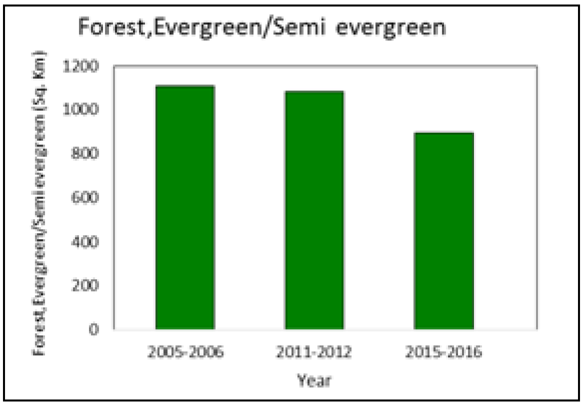

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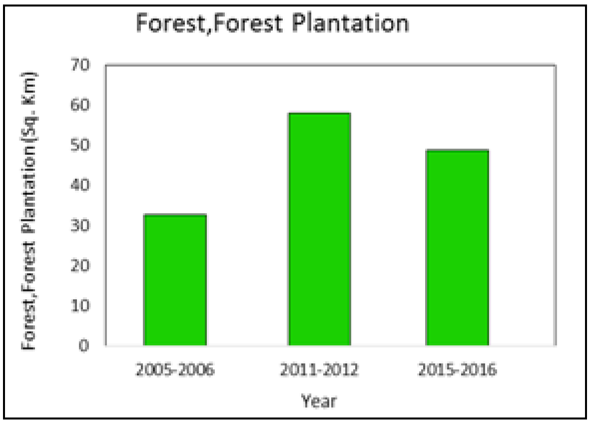
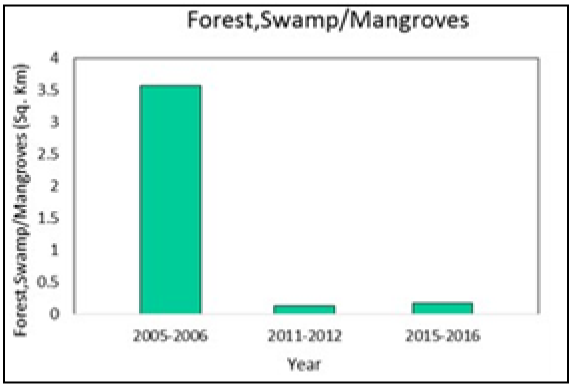
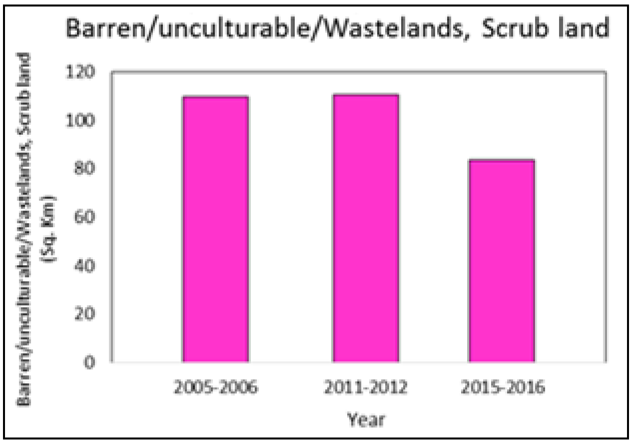

Forest,Forest Plantation
Forest,Forest Plantation (Sq. Km)
70
60
50
40
30
20
10
0
2005-2006
2011-2012
2015-2016
Year

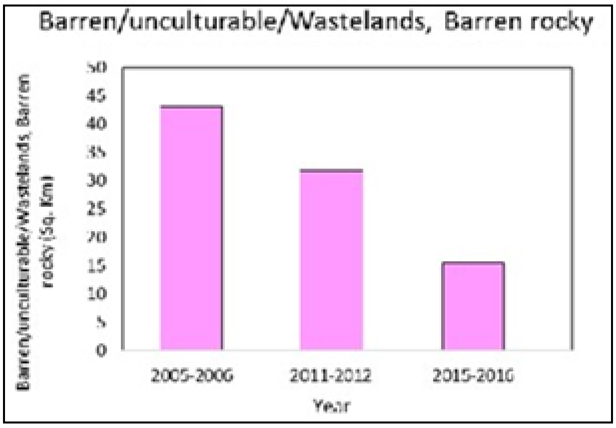
(e)


Forest,Swamp/Mangroves
Forest,Swamp/Mangroves (Sq. Km)
4
3.5
3
2.5
2
1.5
1
0.5
0
2005-2006
2011-2012
2015-2016
Year

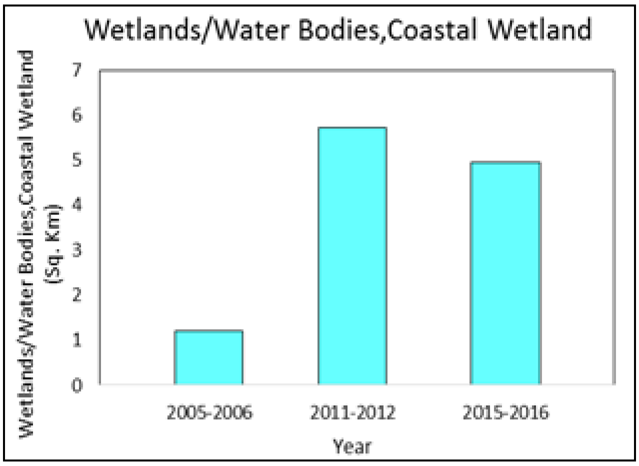
(f)


Barren/unculturable/Wastelands, Scrub land
Barren/unculturable/Wastelands, Scrub land (Sq. Km)
120
100
80
60
40
20
0
2005-2006
2011-2012
2015-2016
Year

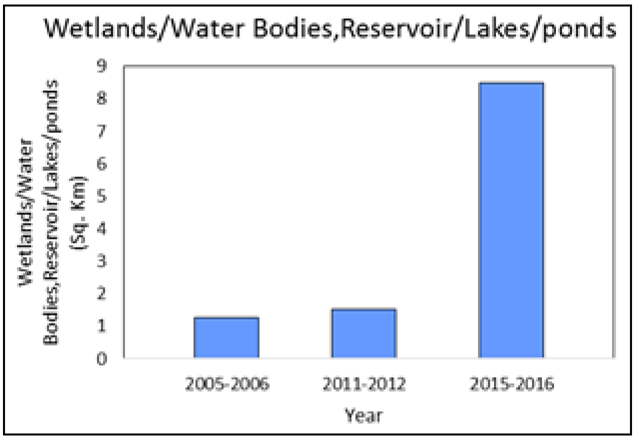
(g)


Barren/unculturable/Wastelands, Barren rocky
Barren/unculturable/Wastelands, Barren rocky (Sq. Km)
45
40
30
25
15
10
0
2005-2006
2011-2012
2015-2016
Year

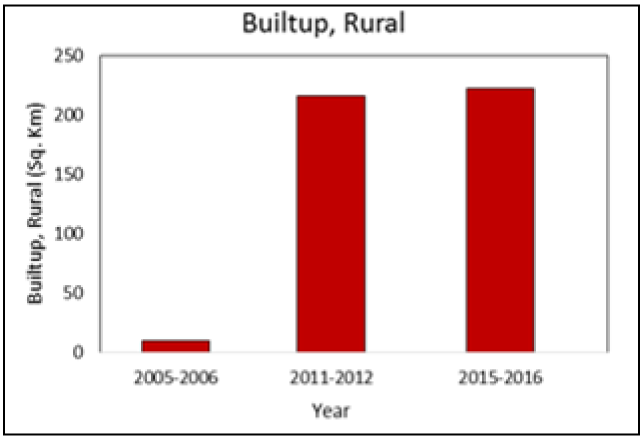
(h)


Wetlands/Water Bodies,Coastal Wetland
Wetlands/Water Bodies,Coastal Wetland (Sq. Km)
7
6
5
4
3
2
1
0
2005-2006
2011-2012
2015-2016
Year

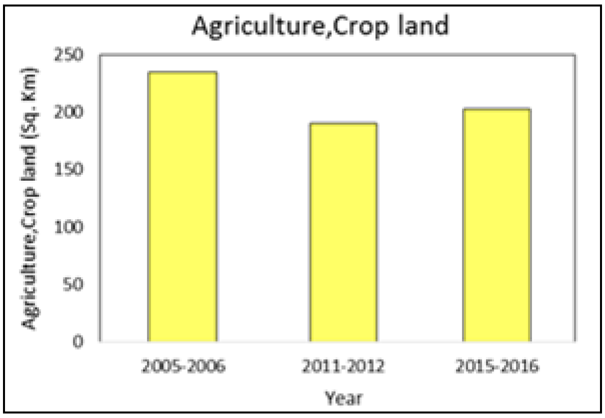
(i)


Wetlands/Water Bodies,Reservoir/Lakes/ponds
Wetlands/Water Bodies,Reservoir/Lakes/ponds (Sq. Km)
9
8
7
6
5
4
3
2
1
0
2005-2006
2011-2012
2015-2016
Year

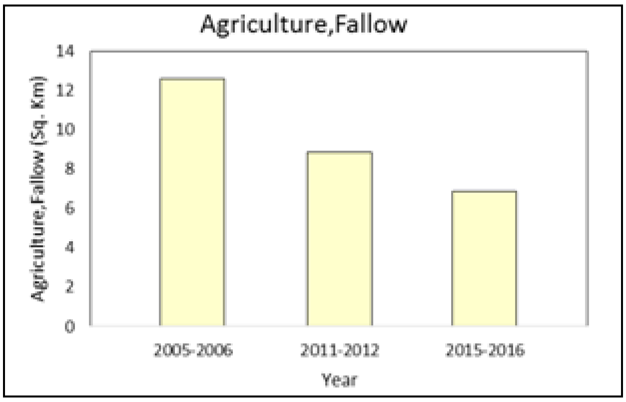
(j)


Builtup, Rural
Builtup, Rural (Sq. Km)
250
200
150
100
50
0
2005-2006
2011-2012
2015-2016
Year

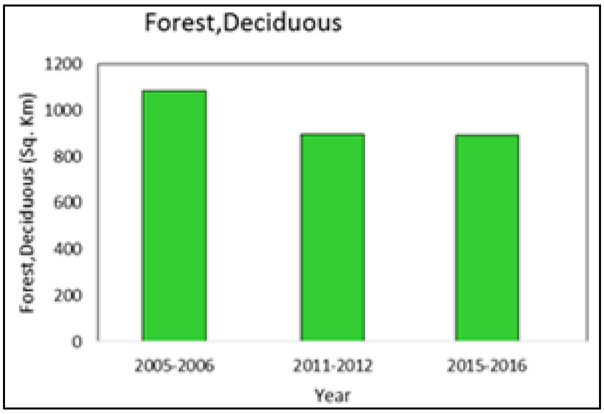
(k)


Agriculture,Crop land
Agriculture,Crop land (Sq. Km)
250
200
150
100
50
0
2005-2006
2011-2012
2015-2016
Year

(l)



(m)



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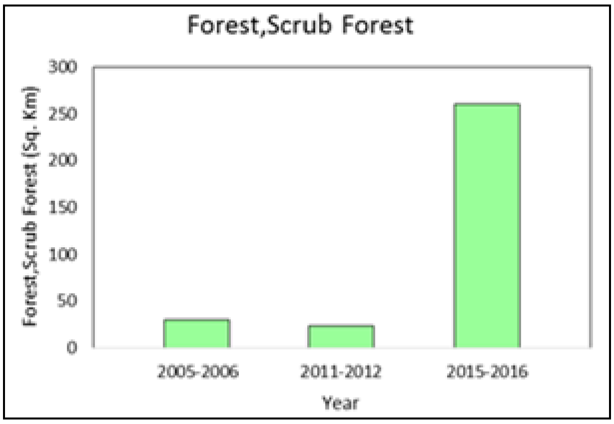
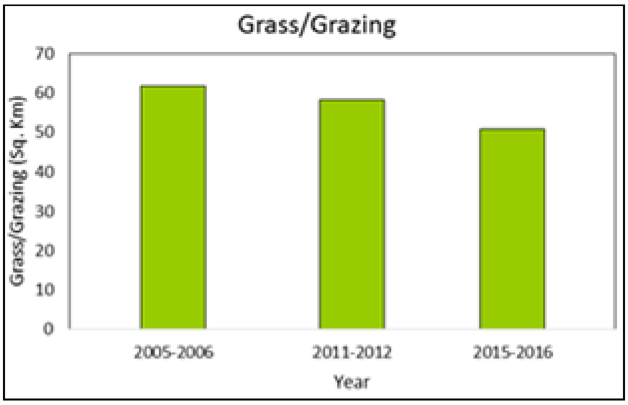


(o)



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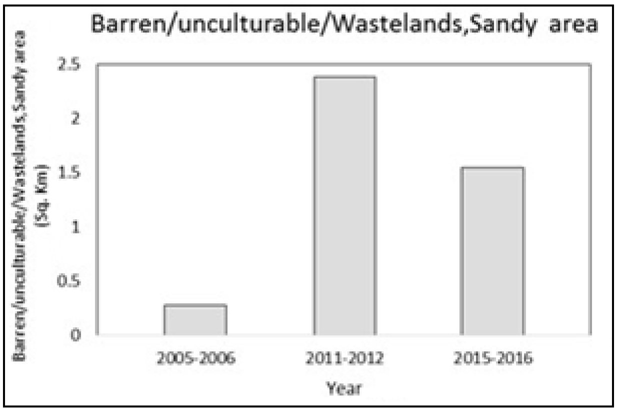
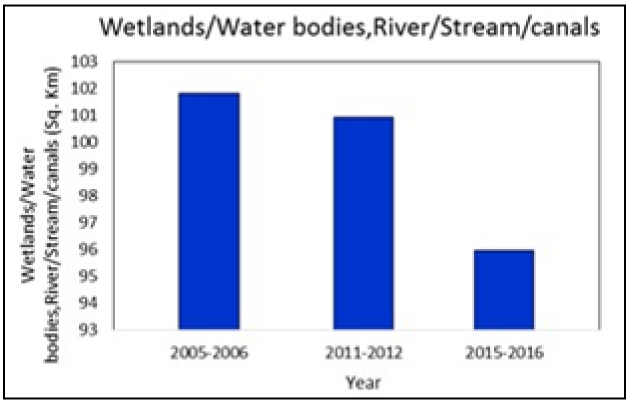


(q)



(r)

Figure 2: The LULC changes

The builtup area includes the residential, mixed builtup, public/semipublic, communication, public utilities/ facility, commercial, transportation, reclaimed land, vegetated area, recreational, industrial, industrial/mine dump, ash/cooling pond. Builtup area has drastically increased from 62.7 Sq. Km to 102.08 Sq. Km in a matter of 5 years and further increased to 162.42 Sq. Km over the period of another 5years. So basically, ithas increased 2.5 times the original built up area over the decade. If you look at the Fig3 (a) in the first half of the decade the increase in built up area is less compared to that of the second half. From 2011 - 2012 to 2015 - 2016 it shows an increase of 62.34 Sq. Km in builtup activities. When the built up area increases then direct environmental impacts habitat loss and fragmentation, and degradation of water resources and water quality. Building on undeveloped land destroys and fragments habitat and thus displaces or eliminates wildlife communities.

Decadal comparison of builtup mining area of the Dakshina Kannada district includes Mine/Quarry, Abandoned Mine pit, Land fill area builtup mining area, Abandoned Minepit, Land fill area. Builtup mining area has drastically increased from 0.03 sq. km to 1.89sq. km in a matter of 5 years and further increased to 6.41 sq. km over the period of another 5 years as seen in Fig.3 (b). If you look at the above graph in the first half of the decade the increase in builtup area is less compared to that of the second half. From 2011 - 2012 to 2015 - 2016 it shows an increase of 4.52 sq. km in builtup mining activities. Environmental impacts of mining can occur at local, regional, and global scales through direct and indirect mining practices. Impacts can result in erosion, sinkholes, loss of biodiversity, or the contamination of soil, groundwater, and surface water by the chemicals emitted from mining processes.

Over the decade the Agriculture and plantation area includes Plantation - agricultural, Horticultural, Agro horticultural. Agriculture and plantation area has slightly increased from 1939.63sq. km to 1946.57sq. km in a matter of 5 years and further drastically decreased to 1883.97sq. km over the period of another 5 years. If you look at the above graph Fig.3 (c) in the first half of the decade the slightly increased in agriculture area is more compared to that of the second half. From 2011 - 2012 to 2015 - 2016 it shows a decreased of 62.6 sq. km in agricultural and plantation activities. From 2005 - 2006 to2011 - 2012 it shows an increase of 6.94 sq. km. in agricultural and plantation activities. One of the major problems facing agriculture is the loss of agricultural land, because as more land is lost, it will become more difficult to produce the amount of food needed to feed the growing human population. If this land is lost, people may find it more difficult to find produce, and rising the prices.

Decadal area comparison of Forest, Evergreen/Semi Evergreen in Fig.3 (d) includes, Dense/closed and Open category of Evergreen / Semi Evergreen. Forest, Evergreen/Semi Evergreen area has slightly decreased from 1107.71sq. km to 1084.61sq. km in a matter of5 years and further drastically decreased to 894.28sq. km over the period of another 5years. If you look at the above graph in the first half of the decade the slightly decreased in forest, Evergreen area in 2005 - 2006 to 2011 - 2012. And it is decreased more in the second half. From 2005 - 2006 to 2011 - 2012 it shows an decrease of 23.1 sq. km. from2011 - 2012 to 2015 - 2016 it shows an decrease of 190.33sq. km in forest and evergreen activities. Shrinking of the forests cause wide - reaching problems like soil erosion, fewer crops, flooding, water cycle disruption, greenhouse gas emissions, changes in the climatic conditions, and loss of biodiversity. When we destroy forests, we add to climate change because forest strap carbon and help stabilize the world's climate. When forests are trashed, the carbon trapped in trees, their roots and the soil is released into the atmosphere. Deforestation accounts for up to 20% of all carbon emissions.

Decadal comparison of Forest, Forest Plantation is as seen in Fig.3 (e). Forest, Forest Plantation area includes, timber, non – timber forest products, protection of clean water, soil erosion control, clean air. Forest, forest plantation area has drastically increased from 32.78 Sq. Km to 57.89 Sq. Km in a matter of 5 years and for next 5 years suddenly decreased to 48.72 sq. km. If you look at the above graph in the first half of the decade the slightly increased in forest and forest plantation. and there is a decrease in area in the second half of the decade. From 2005 - 2006 to 2011 - 2012 it shows an increase of25.11sq. km. from 2011 - 2012 to 2015 - 2016 it shows an decrease of 9.17 sq. km in forest and forest plantation activities. Forest degradation. Human activities that drive forest degradation include overgrazing, demand for fuel wood and charcoal, excessive logging and human - induced fires. Natural causes of degradation include insect pests, storm damage and natural fires.

Forest, swamp/mangroves area includes, Dense/Closed and Open Mangrove. Forest, Swamp/mangroves has drastically decreased from 3.57sq. km to 0.13 sq. km in a matter of5 years and further slightly increased to 0.17sq. km over the period of another 5 years. If you look at the above graph Fig.3 (f) in the first half of the decade the drastically decreased in forest and swamp and there is a slight increase in area in the second half of the decade. From 2005 - 2006 to 2011 - 2012 it shows an decrease of 3.44 sq. km. from 2011 – 2012 to 2015 – 2016 it shows an increase of 0.04sq. km in forest and Swamp/ Mangroves activities. The loss of trees and other vegetation can cause climate change, desertification, soil erosion, fewer crops, flooding, increased greenhouse gases in the atmosphere, and a host of problems for indigenous people.

Decadal comparison of Barren/ Unculturable/Wastelands, Barren Rocky includes barren rocky, deserts, dry salt flats, beaches, sand dunes, exposed rock, gravel pits, strip mines. Barren rocky has decreased from 43sq. km to 31.73 sq. km in a matter of5 years and further slightly decreased to 15.6 sq. km over the period of another 5 years. The Fig.3 (g) shows that in the first half of the decade the drastically decreased in Barren/ Unculturable/ Wastelands, barren rocky and there is a slight decrease in area in the second half of the decade. From 2005 - 2006to2011 – 2012 it shows a decrease of 11.27sq. km. from 2011 - 2012 to 2015 - 2016 it shows an decrease of 16.13 sq. km in Barren/ Unculturable/ Wastelands, barren rocky. When the Barren/ Unculturable/ Wastelands, barren rocky area decreases then direct environmental impacts habitat loss and fragmentation, and Overgrazing, Soil erosion.

Barren/Unculturable/Wastelands, Scrub Land area includes, Dense/Closed and Open category of Scrub Land. Scrub land area has increased from 109.51 Sq. Km to 110.46 Sq. Km in a matter of 5 years and for next 5 years suddenly decreased to 83.68 sq. km. The Fig.3 (h) shows that in the first half of the decade there is slight increase in Scrub Land and there is a decrease in area in the second half of the decade. From 2005 - 2006 to 2011 - 2012 it shows an increase of 0.95sq. km. from 2011 - 2012 to 2015 - 2016 it shows a decrease of 26.78 sq. km in Scrub land. When the Scrub Land area decreases then direct environmental impact is habitat loss. This effect has greatly reduced the value of the vegetation as rangeland.

The Fig.3 (i) shows that the Coastal wetlands area has drastically increased from 1.22Sq. Kmto5.73Sq. Km in a matter of 5 years and for next 5 years decreased to 4.95sq. km. From 2005 - 2006 to 2011 - 2012 it shows an increase of 4.51sq. km and from 2011 - 2012 to 2015 - 2016 it shows an decrease of 0.78sq. km in wetland activities. The negative effects of wetland loss are cumulative. Every time a wetland is lost, or allowed todegrade, theentire watershed loses value to humans, animals and plants. The loss or destruction of wetlands can result in: Loss or degradation of wetland habitat and a loss of plant and animal biological diversity.

The Fig.3 (j) shows the Decadal comparison of Wastelands/ Water Bodies, Reservoir/ Lakes/ Ponds area has increased from 1.27sq. km to 1.53sq. km in a matter of 5 years and further drastically increased to 8.48 sq. km over the period of another 5 years. From 2005 - 2006 to 2011 - 2012 it shows an increase of 0.26 sq. km. from 2011 - 2012 to2015 -

2016 it shows an increase of 6.95 sq. km in Water Bodies/Lakes/Reservoir/ Ponds activities. Causing food prices to sky rocket and threatening economies. Decrease in ground water disproportionately affects the under privileged during drought and dry season. Additionally, drying up of said water bodies slowly erodes the natural landscape and terrestrial ecosystems that come with it.

The Fig.3 (k) shows the Decadal comparison of built up, Rural area which includes, Hamlets, villages, towns, and other small settlements are in or surrounded by rural areas. Built up, Rural has drastically increased from 9.77 sq. km to 215.56 sq. km in a matter of 5years and further increased to 222.12 sq. km over the period of another 5 years. If you look at the above graph in the first half of the decade the drastically increased in Built up, Rural Area. And there is a increased in area in the second half of the decade. From 2005 - 2006to2011 – 2012 it shows an increase of 205.79sq. km. from2011 - 2012to2015 - 2016it shows an increase of 6.56 sq. km in Builtup, Rural. The major problems consist of the agriculture, the ownership of the land, the lack of cottage industries, lack of education social evils, death of animal, wealth, bad wealth and so on. These problems are the result of traditionalism and conservatism of the Rural Society.

Agriculture, Crop Land area includes, Kharif, Rabi, Zaid, Two or more than two cropped areas which is found to decrease from 234.28 sq. km to 190.35 sq. km in a matter of 5 years and slightly increased to 202.19 sq. km over the period of another 5 years. As seen in the graph Fig.3 (l) the first half of the decade has a decreased Agriculture, Cropland area and there is a increase in Crop land area in the second half of the decade. From 2005 - 2006 to 2011 - 2012 it shows a decrease of 43.93 sq. km. from 2011 - 2012 to 2015 - 2016 it shows an increase of 11.84 sq. km in Agriculture, Crop Land. One of the major problems facing agriculture is the loss of agricultural land, because as more land is lost, it will become more difficult to produce the amount of food needed to feed the growing human population.

Agriculture, Fallow has drastically decreased from 12.63 sq. km to 8.89 sq. km in a matter of 5 years and further decreased to 6.86sq. km over the period of another 5 years. If you look at the graph as in Fig.3 (m) From 2005 - 2006 to 2011 - 2012 it shows a decrease of3.74 sq. km. from 2011 - 2012 to 2015 - 2016 it shows a decrease of 2.03sq. km in Agriculture, Fallow Activities. Bare fallow can also affect soil pathogenic microorganisms by removing the host crops, reducing crop residues, and changing the soil physical environment in such a way that the pathogen life cycles are disrupted.

Similarly, the Forest, Deciduous has drastically decreased from 1084.57 sq. km to 897.9sq. km in a matter of 5 years and further decreased to 892.07 sq. km over the period of another 5 years as seen in the graph Fig.3 (n). From 2005 - 2006 to 2011 - 2012 it shows a decrease of 186.67sq. km. from2011 – 2012 to 2015 – 2016 it shows a further decrease of 5.83 sq. km in Forest, Deciduous. When forest decreases it cause direct environmental impacts habitat loss and fragmentation, and degradation of water resources and water quality. The species disappears from regions when the amount of deciduous forest declines below a certain level.

The Scrub Forest area including Current & Abandoned Shifting Cultivation is found to decrease from 30.29 sq. km to 23.07 sq. km in a matter of 5 years and drastically increased to 260.19 sq. km over the period of another 5 years. The graph in Fig.3 (o) shows that from 2005 - 2006to2011 – 2012 there is an decrease of 7.22sq. km. areafrom2011 - 2012to 2015 - 2016 it shows an increase of 237.12 sq. km area in Forest, Scrub Forest area. Although the main environmental condition responsible for the growth of scrublands in dry regions is moisture shortage, other factors may play important roles. In some cases soil is a primary factor in inducing development of scrubland vegetation.

Decadal comparison of Grazing area has decreased from61.95sq. kmto23.07sq. km in a matter of 5 years and further decreased to 50.86 sq. km over the period of another 5years as seen in Fig.3 (p). From 2005 - 2006 to 2011 - 2012 it shows an decrease of 3.68 sq. km. from2011 - 2012to2015 – 2016 it shows an further decrease of 7.41sq. km in Grass/Grazing Area. The acts of compaction and erosion as a result of overgrazing can cause tremendous land degradation. In drier areas, the experience is even worse as a large percentage of pasture and land cover is destroyed, contributing to relentless progression of desertification.

Decadal comparison of Barren/ Unculturable/ Wastelands, shows that the Sandy area has drastically increased from 0.28 sq. km to 2.38sq. km in a matter of 5 years and drastically decreased to 1.54 sq. km over the period of another 5 years. From 2005 – 2006 to 2011 - 2012an increase of 2.1sq. km. and from2011 – 2012 to 2015 – 2016 a decrease of 0.84 sq. km in Barren/ Unculturable/ Wastelands, Sandy Area is found as seen in Fig.3 (q). The sandy area decrease has directly led to the environmental impacts like habitat loss and fragmentation which in turn affects vegetable cultivation of grams, tomatoes, etc.

Decadal comparison of Inland Wetland shows its drastic decrease from 2005 - 2006 to2011 - 2012 to be about 2.96 sq. km. and from 2011 - 2012 to 2015 - 2016 it shows a further decrease of 0.51sq. km in Grass/Grazing Area as in Fig.3 (r). The loss of wetlands leads to environmental and ecological problems, which have a direct impact on the socio – economic benefits of the associated population. Serious consequences, including increased flooding, species decline, deformity, or extinction and decline in water quality could result. Similarly, Decadal comparison of Wetlands, canals has shown drastic decrease from 101.82 sq. km to 100.92 sq. km in a matter of 5 years and further decreased to 95.97 sq. km over the period of another 5 years. Consequence being complete dry land during the dry season, diminished aquatic habitat during the wet season, soil loss, and flattening of the peat surface.

4. Conclusions

1) After the successful study of a decadal data of Dakshina Kannada district, it is found that among the 19 LULC classes studied over a period of 10 years the following conclusions are derived.

2) The classes with a decreasing area trend are agriculture, plantation, forest, evergreen/semi-evergreen forest, forest plantation forest, swamp/mangroves barren unculturable/wastelands, scrubland, barren/ unculturable/ wastelands, barren rocky, agriculture, cropland, agriculture, fallow, forest, Deciduous, wetlands/water bodies, inland wetland, wetlands/ water bodies, river/stream/canals.
3) The classes with a typical increasing trend is the built up urban, built up mining and built up rural, wetlands/water bodies, coastal wetland, wetlands/water bodies reservoir/lakes/ponds, built up rural, and Forest, Scrub Forest.
4) An unusual trend has been observed in the classes like forest, scrub forest, grass/grazing, and barren/ unculturable/ wastelands, sandy area.
5) The main reason behind the changes is not solely the population rise as the population of Dakshina Kannada district in 2001 was 18, 97, 730 whereas, the population in 2011 was 2, 089, 649.
6) The developmental activities which took place in the past decade has led to the sudden changes in the trends of LULC classes. A more elaborative conclusion could be given with a study of at least three decades data.

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