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Land Use & Land Cover Change in Dakshina Kannada District, Karnataka: A Geographical Study

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ABSTRACT

The study of land use pattern is prime concern to geographers to know the relation between man and natural environment (Tripati and vishwakarma, 1988). Land is an important studies particularly relevant to agricultural geography. The term land use and cover are not synonymous and the literature draws attention to their differences so that they are used properly in studies of land use and land cover change. The dakshina Kannada district situated between 12^0 27' and 13^0 58' north latitude and 74^0 47' and 75^0 45' east longitude. To know the decadal variation in the land use and land covers change, this the main objective of study. The technological advances in remote sensing products and digital image processing software are securely blessing to analyze land use studies. The present study concentrate on 2000-01 and 2015-16 land cover, Agricultural land barren land, buildup area, covered in this study.

Key word: Land use & Land cover, Satellite Image, Decadal Variation.

Introduction

The concept of land use is related to the use of land for which land is put in a certain region for given period of time. Land use studies are important, as they are aimed to explain the occurrence of different uses in different areas. They generally aim of explain the constant interaction between available land resource on the one hand and human needs and efforts on the other. Land use, thus, is an expression of permanent struggle in which human efforts are applied to the land resource for the satisfaction of human needs. The competition between various types of uses is the result of scarcity of land. Some land is better than other land for a specific use of defending on physical, economic and cultural characteristics of land to which its suitability for a particular use is related. Therefore, in agricultural geography, it is essential to understand the variations in the land use as a human reaction towards the satisfaction of human wants. The environmental factors no doubt, exert an influencing upon the use to which land is put. This is true especially in the case of rural land use to a great extant reflects cultural and economic response. Land is the basic resource of human society. Its utilization shows a reciprocal relation between the prevailing ecological condition of a particular region and man. Land is the surface utilization of all developed and vacant land on specific point, at a given time and space. The leads on back to the village farm and the farmer, to the fields, gardens, pastures, fallow land and forest and to the isolated farmstead. As a matter of fact, geography deals with the spatial relationship between these aspects and planning. This is because land use changes to meet the variable demand for the land by the society in this new ways and condition of life. The demand for new uses of land may be inspired by a technology change or by a change in the size, composition and requirements of a community same changes are short lived where as others represent a more constant.

In this way, land utilization is the use made of the land by man, as surveyed maps in a series, pasture, mining, transportation, gardening residential, recreational, industrial, commercial, uncultivable waste and barren and fallow land. It is not normally possible to use land for or more purposes simultaneously, though, same times even this is possible only for the pasture woodland. Land use is an import aspect of geographical studies particularly to solve agricultural problems and agricultural development in the study region.

Land Use Classification in India

Land utilization was considered with great importance in India. Detailed statistics of land utilization with mainly give area of land put to different uses are almost continuously available since 1884. In the year, 'the return of Agriculture Statistic of British India'', gave details of area cultivated and uncultivated, crops cultivated and irrigated. Separate statistics of land cropped and under current fallows, land available for cultivation and of area under forest were also collected (Prasad, 2004).

ICAR Nine Fold Land Use Classification (1951)

Sl No.	Category	Definition
1	Forest	All area classed as forests under any legal Enactment or administered as forest, weather state-owned or private
2	Land put to non Agriculture uses	All lands occupied by buildings, roads, railway, or under water e.g. river, canals, etc.
3	Barren and uncultivable land	All barren and uncultivable land which cannot be brought under cultivation like mountain, desert, etc.
4	Permanent pasture and Other grazing land	All pastures and grazing lands permanent or not
5	Land under miscellaneous tree crop	All cultivated land which is not included under 'net area sown'
6	Cultivable waste	Included all lands available for cultivation whether Not taken up for cultivation or taken up for once, but not cultivated currently
7	Fallow other than Current fallow	All land which are taken up for cultivation but are temporarily out of cultivation for a periods of less than one year but not more than five years
8	Current fallow	Comprises cropped area which are kept fallow during the current year
9	Net area sown	Area sown with crops and orchards, counting area sown more than once in the same year only once

USGS Land Cover Classification

The United States Geological Survey (USGS) has been at the core of land cover and land use research and application since the late 1960's. It is the largest operational land cover agency in the world today. Land cover has historically been part of USGS's research heritage, and has been significantly influential in the science of mapping land cover and land use. Current mapping techniques of land cover would not be possible without milestone such as James Anderson's (1976) publication entitled ''A Land Cover Classification System for Use with Remote Sensor Data", produced three hierarchical levels of classifying land cover and land use with level three being the most detailed, representing over 100 land use types. The basis of this classification has been explained in detail by Anderson by means of a policy paper in 1976. According to him, a land use and land cover classification system which can effectively employ orbital and high altitude remote sensor data should meet the following criteria (Anderson, 1971):

1. The minimum level of interpretation accuracy in the identification of land use and land cover categories from remote sensor data should be at least 85 percent.
2. The accuracy of interpretation for the several categories should be about equal.
3. Repeatable or repetitive result should be obtainable from one interpreter to another and from one time of sensing to another.
4. The classification system should be applicable over extensive areas.
5. The categorization should permit vegetation and other type of land cover to be used as surrogates for activity.
6. The classification system should be suitable for use with remote sensor data obtained at different times of the year.
7. Effective use of subcategories that can be obtained from ground survey or from the use of larger scale or enhanced remote sensor data should be possible.
8. Aggregation of categories must be possible.
9. Comparison with future land use data should be recognized when possible.
10. Multiple uses of land should be recognized when possible.

Some of these criteria should apply to land use and land cover classification in general, but some of the criteria apply primarily to land use and land cover data interpreted form remote sensor data.

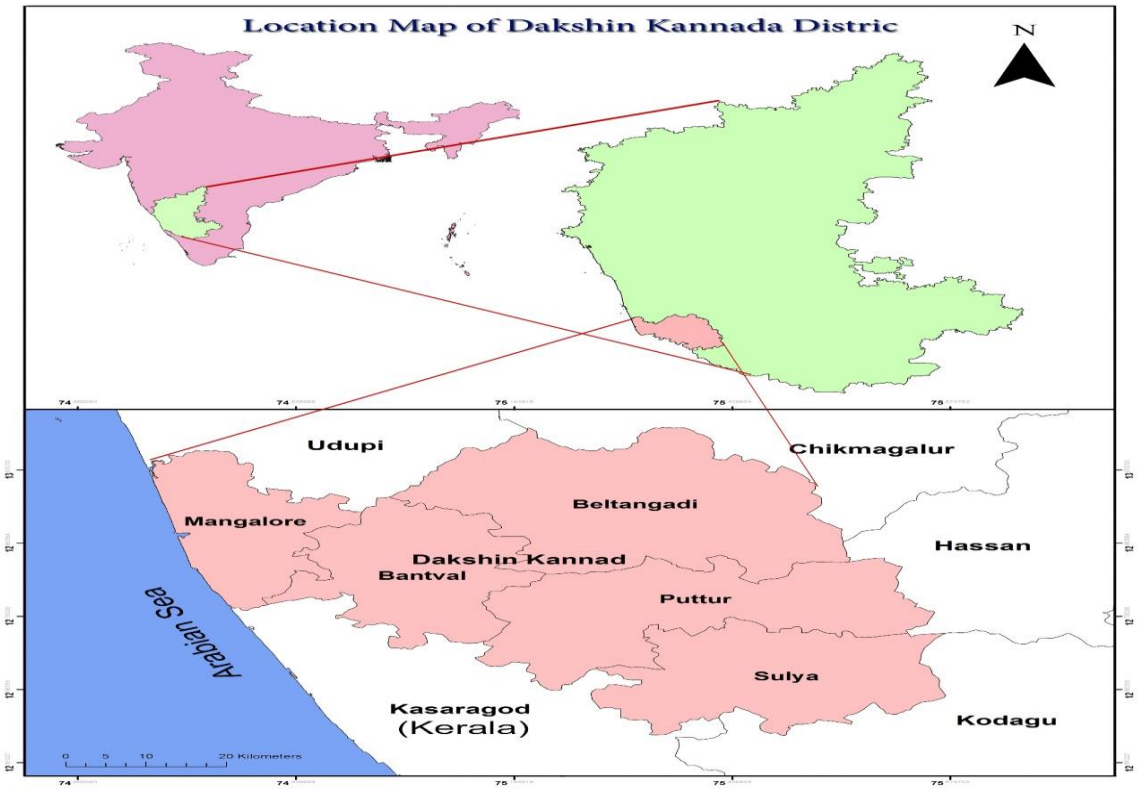
Study area

The assessment of physical position will result in an understanding of the changing impotence of the setting of the given geographical region and also suggest the likely potentialities of the situation for its development in future. Therefore, with this view an attempt is made in this chapter to know the physical background of the Dakshina Kannada district.

The district of Dakshina Kannada is situated on the western coast of India. About half way between Bombay and Cape Comorin. From north to south, it is a long narrow strip of territory and from east to west; it is a broken low plateau which spread from the western Ghats to the Arabian sea known in kannada 'paschim samudra' (western sea) the major parts of its length lies along the

sea board. The area is intersected by many rivers and streams and presents varied and most picturesque scenery. Abundant vegetation, extensive forest, numerous groves of coconut palms along the coast and rice field in every valley, provides a refreshing greenness to the prospect. It is a most densely inhabited tract. Geographically, the Dakshina Kannada region is separated from the rest of south Indian peninsula by the towering heights of the Western Ghats; it spread from the Western Ghats towards the sea to the west. The length of the undivided Dakshina Kannada district's coast-line, which is almost straight, but broken at numerous points by rivers, rivulets, creeks and bays, is 76 nautical miles (140.8 km) now its coastal lines have been reduced to 42 kilometer after the formation of Udupi district. The district lies between 12^0 27' and 13^0 58' north latitude and 74^0 47' and 75^0 45' East longitude.

The district is bounded by Udupi and Karkalla taluks of Udupi district in the north, Mudigere taluka of Chikkamagalur district on the north east, Sakalespur taluk of Hassan district on the east, Madikeri and Somawarapet taluks of Kodagu district in the southeast and Kannur district of Kerala state on the south and is surrounded by the Arabian Sea on the west.



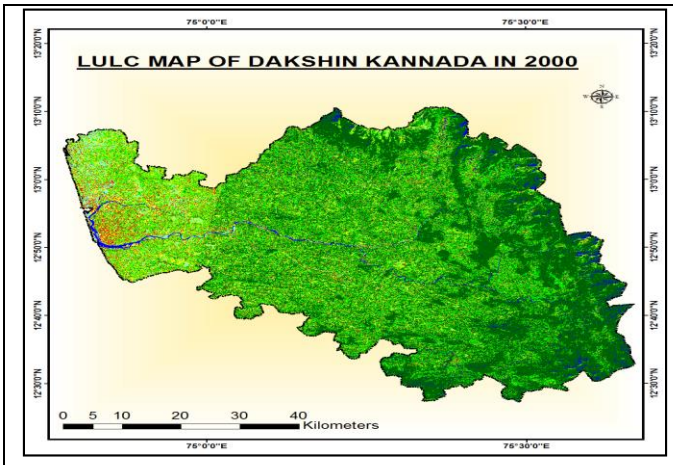
Objectives

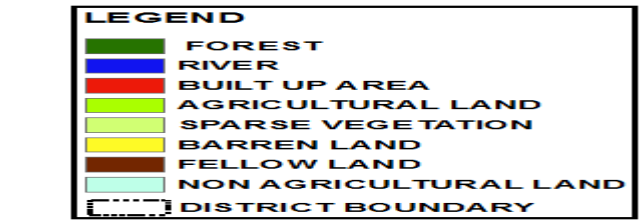
To know the decadal variation in the land use & land cover change.
To know the how the land use % land cover change impact on environmental issues of the study region, and
To know the role of Govt/politician/planners scientists for changing land use & land cover scenario in the study region.

Methodology

Secondary data have been collected from the directorate of economic and statistics, Bangalore, Govt of Karnataka, Bangalore. Simple statistical methods are used to show the result variation like, bar graph, standard deviation etc. table etc. table for both study the study periods have been prepared with percentage conversion.

Satellite~imageregistration~signature collection image classication~accuracy assessment~satisfactory~LULC MAP





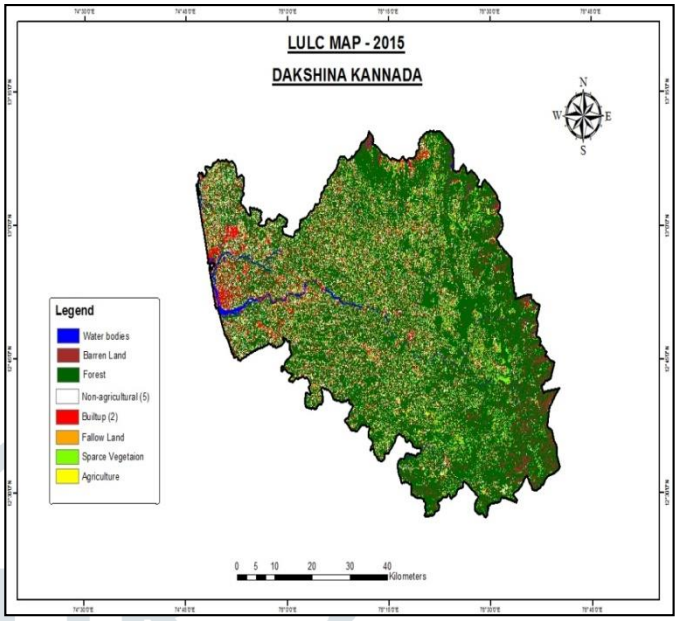


Table No.1

	2000-01		2015-16			
TYPES OF LAND USE	**AREA (Sq.km)**	**% OF AREA**	**AREA (Sq.km)**	**% OF AREA**	**VOLUME OF CHANGES (Sq.km)**	**PERCENTAGE OF CHANGES (%)**
Forest Land	2013.31	44	1972.3	43.2	-41.0	-0.8
Water bodies	111.11	2.4	115.5	2.5	4.4	0.1
Agricultural Land	1148.69	25	989.2	21.7	-159.5	-3.3
Fallow Land	424.56	9.3	282.2	6.2	-142.4	-3.1
Sparse Vegetation	377.41	8.2	366.1	8.0	-11.3	-0.2
Baren Land	279.74	6.12	219.7	4.8	-60.1	-1.3
Built Up Land	84.81	1.85	238.7	5.2	153.9	3.4
Non-Agricultural Land	124.54	2.72	380.5	8.3	255.9	5.6
Total	**4564.17**	**99.59**	**4564.1**	**100**		

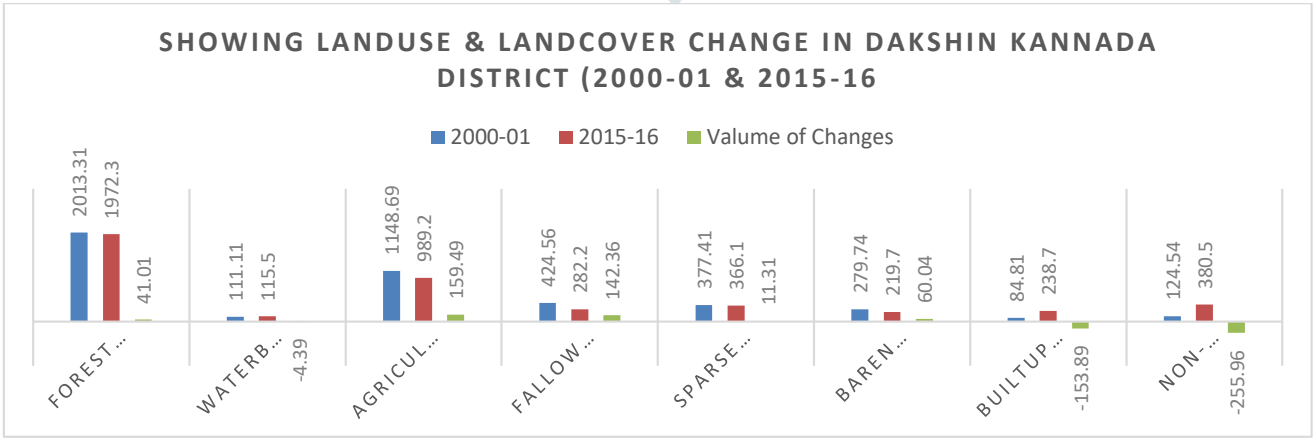
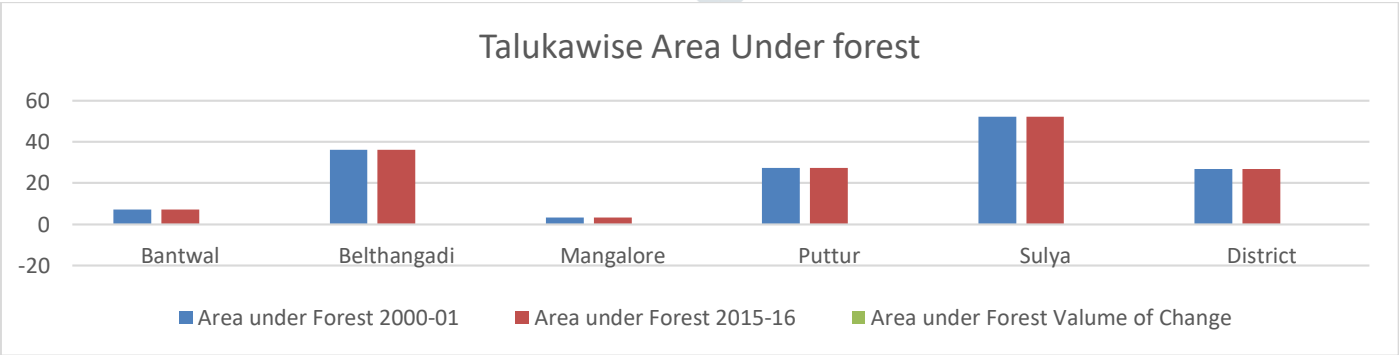


Table No.2 Taluka Wise General Land Use in Dakshina Kannada district (2000-01 and 2015-16)

Land Use	Year	Bantwal	Belthangadi	Mangalore	Puttur	Sullia	District
Area under Forest	2000-01	5069	49837	2902	27386	43282	128476
	%	7.06	36.24	3.40	27.46	52.12	26.92
	2015-16	5069	49837	2902	27386	43282	128476
	%	7.06	36.24	3.39	27.46	52.12	26.91
	Volume of Change	00	00	-0.01	00	00	-0.01
Area not available for Cultivation	2000-01	22946	26377	29171	30727	6420	115643
	%	31.97	19.18	34.25	30.82	7.73	24.23
	2015-16	23779	30437	34990	31671	6614	127491
	%	33.13	22.13	40.97	31.76	7.96	26.70
	Volume of Change	1.16	2.95	6.72	0.94	0.23	2.47
Other Uncultivable Waste Land	2000-01	15338	22995	19287	17164	12449	87233
	%	21.37	26.72	22.64	17.21	14.99	18.28
	2015-16	13986	16782	19684	9506	7584	67542
	%	19.49	24.84	23.05	9.53	9.13	14.14
	Volume of Change	-1.88	-14.14	0.41	-7.68	-5.86	-4.14
Follow Land	2000-01	2146	1440	6040	2758	411	12795
	%	2.99	1.04	7.09	2.76	0.49	2.668
	2015-16	1051	1440	7789	2297	131	12708
	%	1.46	1.04	9.12	2.30	0.15	2.66
	Volume of Change	-1.53	00	2.03	-0.46	-0.34	-0.02
Net Sown Area	2000-01	34233	42752	38346	25008	20781	161210
	%	47.70	31.09	45.03	25.08	25.02	33.78
	2015-16	34709	46717	26750	31889	26090	166155
	%	48.36	33.97	31.32	31.98	31.42	34.80
	Volume of Change	0.66	2.88	-13.71	6.9	6.4	1.02
Total Geographical Area	2000-01	71758	137510	85153	99697	83031	477149
	%	100	100	100	100	100	100
	2015-16	71758	137510	85385	99697	83031	477381
	%	100	100	100	100	100	100

Source- Socio-Economic Abstract of Dakshina Kannada District 2000-01 & 2015-16.

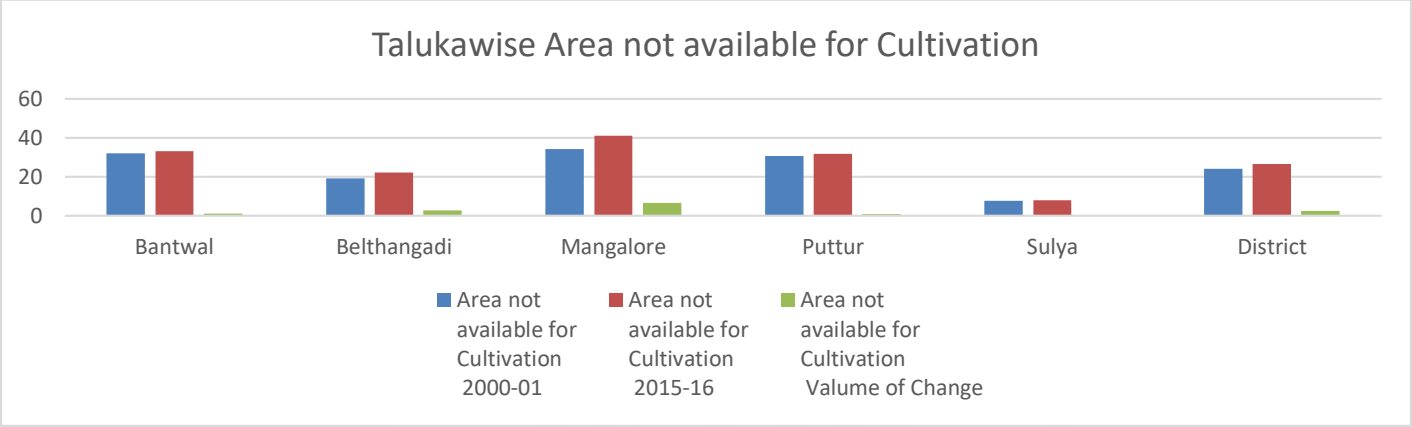
Area under Forest



The categories include any land classed or administered as a forest under legal enactment. The area figure under grazing lands or a crop within the forest is also included in the area under forest. It is clear from (table) and map area about 128476 (sq. km hectares) or 26.92 of the total 2000-01. Forest area are not increased and decreased from 1, 28,476 hectares. To 1, 28,476 hectares. During this period of investigation. Though the area under forest has maintained same area of during the period of investigation it is less than average for Karnataka. Area under forest varies from taluk to taluk in the district map shows that out of the total geographical area less than 5% area was under forest in Mangalore, and Bantwal taluk 7.06%, geographical area was noticed under

forest in Sullia (52.12%), Belthangadi, (36.29%) and Puttur (27.46%) of area under the forest during the period 2000-01. There were no change under forest in my study period, only Mangalore taluka forest area changed that (-0.01%) very less. In Dakshina Kannada district. Mangalore and Bantwal taluk covered less forest area because Mangalore and bantwal taluka located plain area and it's covered as urban growth. Sullia taluk covered highest area under forest that is 52.12% of total geographical area. Because this taluka located adjoin part of Western Ghats, Belthangadi (36.24%) and puttur (27.46%) covered area under forest in Dakshina Kannada district.

Area Not Available For Cultivation

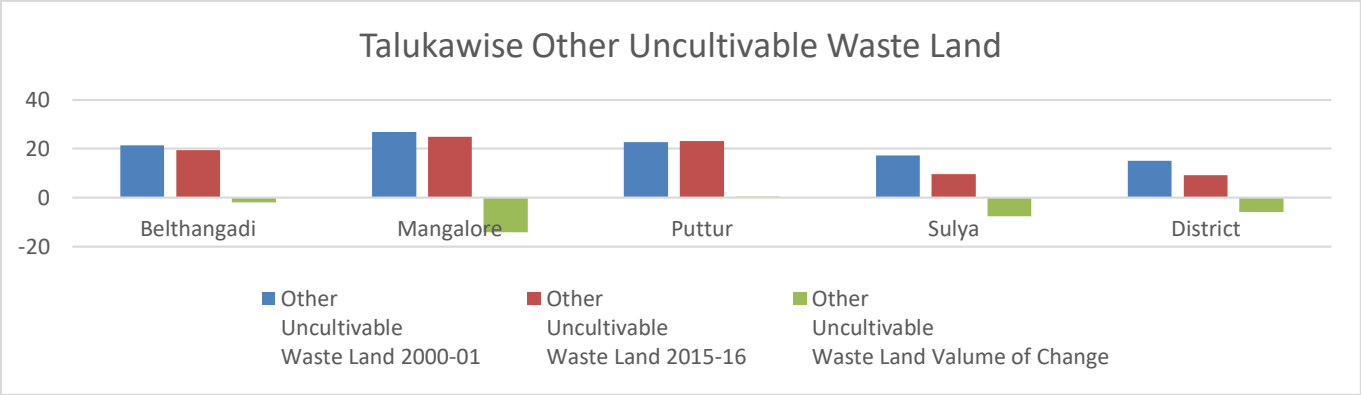


This category includes

1) The land put to non-agricultural use
2) Barren and un cultivable land

Barren and uncultivable land are rocky out crops of hills, plateaus, mountains etc. this land can under no conceivable circumstances be brought under cultivation but at a very high cost a very little proportion may be classed as uncultivable land which shows a close association with other uncultivated land. Area under non-agricultural use covers all lands occupied by settlement, roads, rail ways, and beds of streams, and ponds. The Western Ghats of the study region have relatively higher proportion of these lands mainly due to adverse physiographic condition like rugged hilly areas. Steep slopes; rocky exposures, literacy cap cover and salt affected inter tidal areas. Out of the total geographical area of Dakshina Kannada district an average was 24.23%. This is more than three times to the average area under this group for the state. Taluk wise distributional patterns under these categories are exhibited in map area belongs to this category which is much higher as compared to state average. Out of the total geographical area below 20% area. Was found under this category in Sullia taluka and 25% to 35% area is observed in Bantwal. Belthangadi and Puttur. There is remarkable variation in the distribution of land under this category, Bantwal & Mangalore taluks recorded over 40.97% and area changed in this Belthangadi taluk remaining three taluka there no much changes area under in this category during the period of 2015-16.

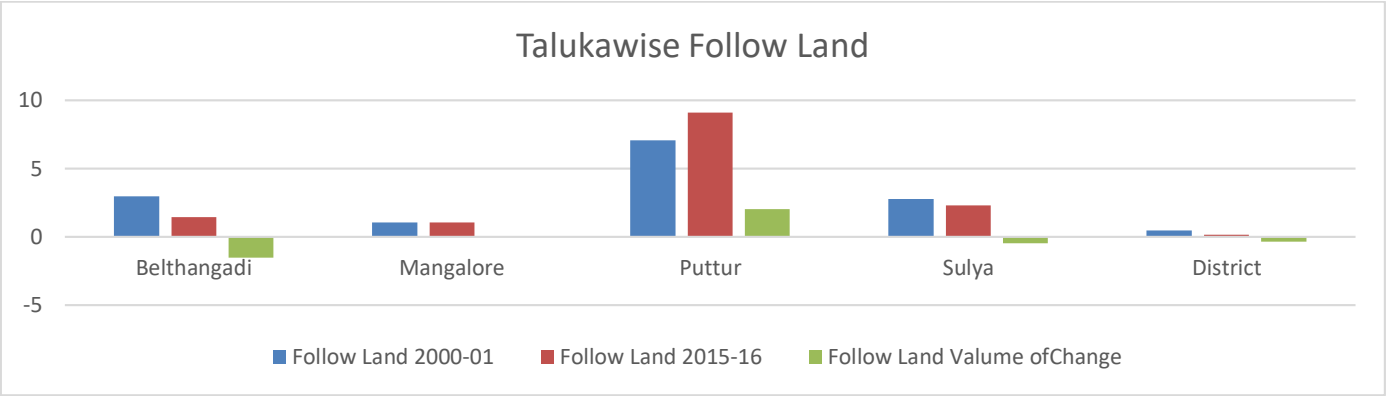
Uncultivable Land (waste land)



This category of land consist of (a) cultivable waste (b) permanent pastures and grazing land (C) land under miscellaneous tree crops etc., cultivable waste land included the land which can be brought under cultivation but have not been cultivated for some time and not been cultivated successively for more than five years. The category of miscellaneous trees, crops included land under casuarinas tree, grass, bamboo bushes or other threes used for fuel. Actually, these are the land which is put to same agricultural use but whose area extent is not included in the category of net area sown. Total area under this category is 18.28% which is much less as compared to Karnataka in 2000-01. The lands under the category of uncultivable excluding fallow land have also recorded a considerable decrease during 2000-01-2015-16. Period, which slightly deceased by -4.14 percentage. Dakshina Kannada district had

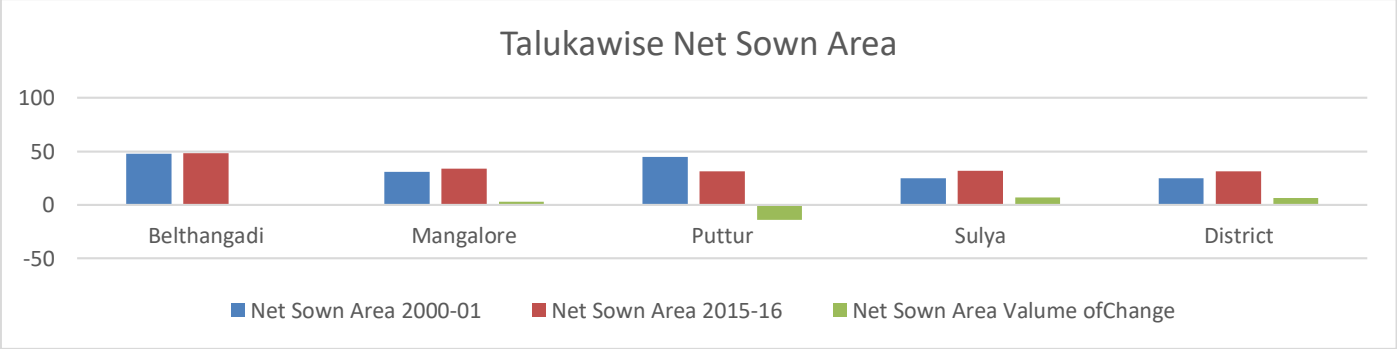
87.233 hectares.(18.28%) of land under this categories of land use in 2000-01, and it is decreased to 67.542.(14.14%). The net decreased is 19,691 hectares of land during the span of fifteen years. In 2000-01 the maximum concentration of this types of land was noticed in Belthangadi 22,995 hectares. (26.72%) and minimum was in Sullia 12449 hets (14.99%) and this was followed by Bantwal 15,338 hectares. (21.37%), Puttur 17164 hectares. (17.21%) and Mangalore 19287 hectares (22.64%). During the year 2015-16 Bantwal taluk has 13,986 hects (19.49%), Belthangadi 16.782 hects, (24.84%), Mangalore 19,684 hectares, (23.05%) Puttur 9,506, hectares (9.13%) and Sullia 7584 hectares (9.03%),. The net decrease of land is 19.67% hectares (-4.14%), which is left for uncultivable and lost fertility of the soil over a period of fifteen years.

Fallow Land



The term fallow applied to the lands, which were not under crops at the time of reporting, though they were sown in the immediate past. The fallow lands are generally divided into two groups i.e., old fallow land and current fallow lands old fallow lands which comprise those lands that have been left uncultivated for more than five years and current fallow lands which include land that were not sown at the time of crop reporting but were sown one or two years or left fallow either in one season or for one complete year to replenish to soil fertility. land which were taken up for cultivable but have been temporarily put off from cultivation for a period of not less than one year but not more than five years due to object poverty of cultivation, inadequate supply of water, silting of canals and rivers etc. (agricultural statistics, 2015-16). During the period 2000-01, the area of the land under this category of use was 12,795 hectares which constituted 2.68 percentage of the total geographical area of the district. It decreased to 12,708 hectares in 2015-16. The talukwise analysis reveals that Bantwal 2146 hectares, (2.99%), Belthangadi 1440 hectares, ()1.04%, Mangalore 6040 hectares, (7.09%), Puttur 2758 hectares, (2.76%), and Sullia 411 hectares, (0.49%) in 2000-01. During the years 2015-16 Bantwal 1051 hects, (1.46%), Belthangadi 1440 hectares. (1.04%), Mangalore 7789 hectares (9.12%) Puttur 2297 hectares, (2.30%) and Sullia 131 hectares, (0.15%). Except Mangalore taluk all other taluks have decreased fallow land during the year 2000-01 to 2015-16. Therefore, this factory has much bearing on the higher increase of agricultural efficiency in Dakshina Kannada district. Mangalore taluka increase mainly because of urbanization process, government wants to create for residential (MUDA, Housing Board) layout, factories, and culture purpose etc.

Net Sown Area



This category constitutes the extent at cropped land in any region and therefore, it is of vital significance in studies related to agricultural geography. The net area sown is the some cropped area in that year. Total area under this land use category is 33.78 percent which is much less as compared to Karnataka in 2000-01. Since, the region under study is relatively urbanized because it is dominated by city of Mangalore and the margining of the number of villages in the shifting of land in the other categories such as land for housing, industrial establishment and various other purposes. This is clear from the facts that the proportion of land net sown was 33.78% during 2000-01, and further it increased to 34.80 percentages in 2015-16. Below 5 percent positive change in net sown area were found in Puttur and Sullia talus during 2000-01 to 2015-16, on the other hand, below 5 percent negative change were observed in Bantwal, Belthangadi and Mangalore taluk during the same period. The drift of population from agricultural activities to other jobs is evident from the decreasing net sown area of the district (Agricultural statistics, 2015-16). The net sown area was 1, 61,210 hectares

((33.78%) during 2000-01and it is increased to 1,66,155 hectors (34.80%) in 2015-16. Thus the analysis of the land utilization in the district revealed the fact that the non-agricultural land use shows an increasing trend in the district. The area under current fallow in decreasing. All other types of land use including forest, permanent pastures and grazing land fallow other than current fallow, cultivable waste, land under miscellaneous tree crops and barren and uncultivable land shows a decreasing trend.

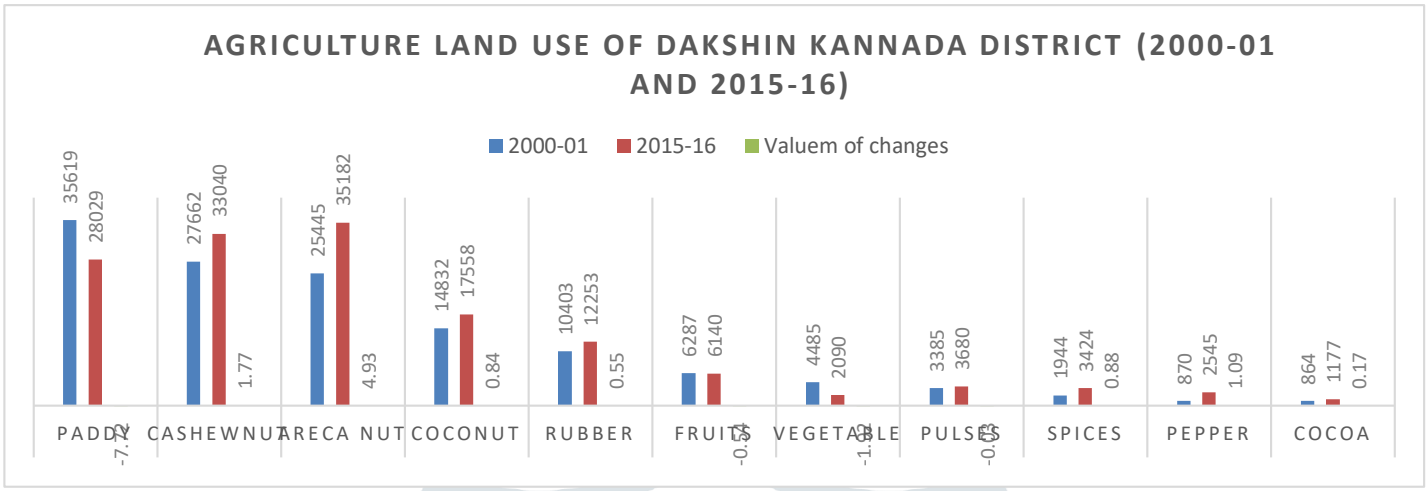
Agricultural Land use

The land, which is used for cultivation of food crops or fodder crops or cash crops is known as agricultural land use or crop land use. So, agricultural land use constitutes the use of cultivable land to grow different crops over a specific period of time. The study of crop land use is an important aspect in the study of agricultural geography. As such, India is an agricultural country and about 70% of the total population is directly or indirectly engaged in agriculture. Agriculture is the main determinant of human life, the fore, people have tried to use the land is the production of as such as crops owing to increased population pressure as well as to earn money. Emphasizing, cash crops rather than food crops. Considering the shortage of food, most of the Indian formers have realized the importance of the production of crops as much as possible. They have been trying to increase the yield by improving the traditional methods of agriculture i.e., but using, improved variety of seeds, chemical fertilizer, improving irrigation facilities growing crops in shorter period, giving higher yield and growing several crops in within a year. Rich farmer have converted most of the single cropped land into double or triple cropped land. Thus, the farmers hardly give rest to fertile land. The agricultural land under different crops in Dakshina Kannada district bears close relation with not only Physical agro-climatic conditions but also with economic, social, and infrastructural facilities of agriculture. During the study period (2000-01 to 2015-16) there have been changes under crops land use in the district. In the year 2000-01, 1,61,210 hectares.(33.78%) of land was under net area sown. Whereas, it increased to 4,945 hectares. (1.02%) of land within 15 years periods. This increased land is not brought from fallow land, other cultivable land (excluding fallow) and also dry grass, lands, permanent pastures and other grazing, land of agriculture, the government has to take steps towards increase of net sown area in the district. This net decreased of land under net sown, is not good sign of agriculture development of Dakshina Kannada.

Table No.3 Agriculture Land use of Dakshina Kannada district (2000-01 and 2015-16)

	2000-01			2015-16		
Sl, No	**Crops**	**Area (in'00'hects)**	**Percentage of Net sown**	**Area (in'00'hects)**	**Percentage of Net sown**	**Volume of changes**
		2000-01		2015-16		
1	Paddy	35619	27.03	28029	19.31	**-7.72**
2	Cashew nut	27662	20.99	33040	22.76	**1.77**
3	Areca nut	25445	19.13	35182	24.24	**4.93**
4	Coconut	14832	11.25	17558	12.09	**0.84**
5	Rubber	10403	7.89	12253	8.44	**0.55**
6	Fruits	6287	4.77	6140	4.23	**-0.54**
7	Vegetable	4485	3.36	2090	1.44	**-1.92**
8	Pulses	3385	2.56	3680	2.53	**-0.03**
9	Spices	1944	1.47	3424	2.35	**0.88**
10	Pepper	870	0.66	2545	1.75	**1.09**
11	Cocoa	864	0.64	1177	0.81	**0.17**
	Total	**131749**	**100**	**145118**	**100**	

Source: Researcher has calculated, based on data available.



Changes in Area of Different Crops in the district from (2000-01 to 2015-16)

Paddy

Paddy is principally a tropical crop, which requires high temperature, high humidity and wet soil throughout its growth. It requires 21^0-24 ^{0} C temperatures. And an average annual rainfall of 150cm. it can also grow in areas where rainfall is less than 150cms, provided such areas have enough irrigational facilities. Deep fertile clay or loamy soil is best suited for rice crop. During the year 2000-01, the district had an area of 35,619 hectares. (27.03%) under paddy cultivation, Mangalore taluk occupied highest land under the rice crop i.e., 13,016 hectares. (36.54%) and it was followed by Bantwal 9,750 hectares. (27.37%), Belthangadi 8,408 hectares. (23.60%), Puttur 3,960 hectares. (11.11%) and in sullia taluka very little area under rice has been noticed. i.e., 485 hectares. (1.36%). During 2015-18, the district has 28,029 hectares. (19.31%) which shows the decrease of areas i.e., 7,590 hectares under paddy cultivation within fifteen years. The taluk like Mangalore 8,901 hectares. (31.75%), Bantwal 8568 (30.56%) Belthangadi 7570 hectares. (27.00%) Puttur 2500 hectares (8.91%) and Sullia 490 hectares, (1.74%) have maintained their highest land under rice, remaining taluks are very little area under paddy which has been noticed in the district.

Pulses

The important pulses in the district are alsandi (cheavli), Aware (Val). Ect. These pulses were grown in arid and semi-arid condition and can also in irrigated tracks. The crops are generally grown in rabi season. These require a mild and cool weather and rainfall of 35-50 cms. These pulses grow well in loamy soil. Usually these pulses are cultivated along with the major crops like paddy, coconut etc. Sowing is done in the months of September October and harvesting takes place in January/February. During 2000-01, the district had 3,385 hectares., (2.56%) of land under pulses, Mangalore occupied highest land under pulses i.e., 2347 hectares, (10.85%) and fallowed by Bantwal 468 hectares., (1.54%), Belthangadi 418 hectares., (1.13%), Puttur 150 hectares., (0.09%), remaining one taluk which grows small proportion of land under pulses. During 2015-16, the district had 3680 hectares. (2.53%) of land under the pulses and within a span of fifteen year period (from 2000-01 to 2015-16) increased in area under the same is noticed. Mangalore taluka, had 1949 hectares. (8.90%) followed by Belthangadi 593 (1.49%) Bantwal 582 hectares, (2.07%), Sullia 366 hectares (1.42%) and Puttur 190 hectares (0.64%).

Coconut

Coconut is mostly grown in coastal districts. It extended over the 12.09% to net sown area in 2015-16. Area under coconut has steadily increased from 2000-01 to 2015-16. In 2000-01 area under coconut was 11.25% to net sown area. Pests and plant discises cause a serious loss to agriculture production. It is not always possible to estimate accurately the extent of loss caused by the pests as it depends upon the severity of infestation in any particular year. There are various pests of crops known to the region rhinoceros beetle is stoat elongated, kind of pests and is harmful to coconut plant and big trees. It may be the cause of insignificant area under coconut in the region. During 2000-01, the district had 14,832 hectares. (11.25%) of land under coconut crop. Mangalore taluk had highest area under this crop i.e., 3177 hectares (14.69%) and followed by Puttur 2227 hectares., (`10.34%), Belthangadi 3752 hectares, (10.15%), Bantwal 2937 (9.72%), Sullia 1985 hectares (9.59%) area under coconut cultivation in the district. During 2015-16, the area under coconut increased to 17,558 hectares, (12.09%). Belthangadi taluk noticed area under the coconut and the

area increased 5295 hectares, (13.34%) followed by Mangalore 3441 hectares (15.71%), Puttur 3397 hectares , (11.60%), Bantwal 3302 hectares and remaining one taluk like Sullia 2123 hectares, (8.29%) area cover under the coconut cultivation in the district.

Cashew nut

Cashew tree are genuinely tropical and very frost sensitive the tree grown in a wide spectrum of climatic regions between the 25° N and S latitudes. Although mean 25° c is regarded as optimal yearly rainfall of 1000mm is sufficient for production but 1500 to 2000 cm can be regarded as optimal. The cashew tree has well developed root system and can tolerate, drought conditions. Rain during the flowering season causes flower abortion due to the ground rain and overcast weather which causes the nuts to root or start germinating. The cashew is a strong plant that is renowned for growing in soil, especially sandy soil, that are generally unsuitable for other fruit trees Well-drained sandy or sandy- loam soil is recommended cashew tree will not grow in poorly- drained soil. During 2000-01, the district had 27.662 hectares, (20.91%) of land under cashew nut crop. Belthangadi taluk accounted highest are under cashew i.e., 8898 hectares (24.07%) followed by Bantwal 5121 hectares (16.95%), Mangalore 3523 hectares, (16.29%), Puttur 5706 hectares, (24.64%), and remaining Sullia taluk noticed 4229 hectares, (20.44%). During 2015-16, district occupied 33,040 hectares, (22.76%), 1.77% of land under cashew crop within a span of fifteen years periods (from 2000-01 to 2015-16) 5378 hectares, of land increased under the same is noticed in most of the taluks. Belthangadi taluk had highest area i.e., 9422 hectares, (23.73%), followed by Puttur 8247 hectares, (28.17%).

Fruits

Fruits are mostly grown in the coastal area. The important fruits grown in the region are bananas, jackfruits, mangoes, etc. Fruits occupy an area of 4.23% to net sown in 2015-16. The table shows the area under fruits in the region. The area under fruits in the region in 2000-01 (4.77 percent to net sown area) has decreased by –0.54 percent in 2015-16. After 2000-01 area under fruits continuously decreased from 4.77% to 4.23 percent in 2015-16. Best periods for plantation are from May to June. Banana requires ample irrigation. Flowering starts after nine months and continues from eighteen to twenty months for maturing after planting. It can be allowed to multiply in the same field. The crop is harvested when the fruits get rounded and petals drop down. The plant is cut down immediately after the bunch is harvested.

Areca nut

In Dakshina Kannada, the area went up from 25,445 hectares to 35182 hectares (increased by 9.737 hectares) during the period. The cultivation of areca nut is mostly confined to 28^0 north and south of the equator. It grows well within the temperature range of 14^0c and is adversely affected by temperature below 10^0c and above 40c. Extremes of temperature and wide diurnal variation are not conductive for healthy growth of the palms. Areca nut can be grown in area receiving annual rainfall of 750mm in maidan parts of Karnataka to 4500mm in malnad area of Karnataka. In area where there is prolonged dry spell, the palms are irrigated. Due to its suitability to low temperature, a good crop of areca nut cannot obtain at altitude of more than 1000m MSL. The largest area under the crop is found in gravelly lateritic soil, sticky clay, alluvial. Brackish and calcareous soil is not suitable for areca nut cultivation. During 2000-01, the district had 25445 hectares, (19.31%) of land under area areca nut. Sullia taluk had highest area under this crop i.e., 7014 hectares.(32.57) followed by Belthangadi 6624 hectares,(17.92%), Puttur 5305 hectares(25.64%), Bantwal 5121 hectares (16.95%), and Mangalore taluk had least area under Areca nut in the district. i.e., 1381 hectares (6.385). During 2015-16, the area under Areca nut increased to 35182 hectares (43.89), Sullia taluk noticed again highest area under the Areca nut i.e., 11,237 hectares, (43.89%). Followed by Puttur 8928 hectares (30.50%), Belthangadi 7430 hectares (18.72%), Bantwal 5706 hectares (20.30%) and Mangalore taluk noticed lowest area under Areca nut in the both study period. i.e. 1881 hectares (8.59%)

Cocoa

Cocoa plant is a small (4 to 8m height) evergreen tree in India, it is mainly cultivated in Karnataka, Kerala, and Tamilnadu as intercrop with areca nut and coconut, Slowly the area under cultivation is being promoted by many chocolate production companies as contract farming'' Cocoa can be grown up to 300m above mean sea level and it requires a minimum of 90-100mm rainfall per month with an annual rainfall 1500-2000mm. The plant need equitable climate with well distributed rainfall. If dry periods are prolonged, irrigation scheduling is necessary. The temperature range of 15-39 ^{0}c with optimum of 25 ^{0}c is considered ideal. Cocoa requires deep well drained soil. Poorly drained soil affects growth of plants. Majority of area under cocoa cultivation is on clay loam and sandy soil. It grows well in the PH range of 6.5 to 7.0. During 2000-01, the district had 864 hectares, (0.65%) of land area under cocoa crop. Puttur taluk had highest area under this crop ,i.e., 282 hectares (1.30%), Belthangadi 236 hectares, (0.63%), Sullia 206 hectares, (0.99%), Bantwal 112 hectares (0.37%) in Mangalore i.e., least area under cocoa in the district. During 2015-16, the area under cocoa increased to 1177 hectares. Puttur taluk noticed highest area under the cocoa which increased to 424 hectares, (1.44%) followed by Bantwal 265 hectares. (0.94%), Belthabgadi 289 hectares, (0.72%), Sullia 167 hectares (0.65%) and Mangalore taluk noticed lowest area under cocao in the both study period. i.e., 32 hectares, (0.14%).

Rubber

The total area under rubber cultivation in Dakshina Kannada was 10403 hects during 2000-01. In the succeeding years there had been a rapid expansion on cultivated area of rubber. Between 2000-01 and 2015-16, there was increase of 12253 hectors, showing a growth of 8.44 %. However, the post liberalization period represented a slow increase of only 1850 hectares 0.55% growth between

2000-01 and 2015-16. It can be found that the growth rate of area under rubber cultivation had been very significant both for pre and post liberalization series. The rate of growth was 0.55% during the pre-liberalization period whereas the rate of growth declined to both study period. During 2000-01, the district had 10403 hectares, (7.89%) of land under rubber. Sullia taluk had 5668 hectares (27.39%), and followed by Belthangadi 3596 (9.73%), Puttur 737 hectares (3.42%0, Bantwal 217 hectares (0.71%) and Mangalore taluk was grown small proportion of land under rubber. During 2015-16, the district had 11253 hectares (8.44%) of land under rubber, Sullia taluk again noticed highest area under rubber cultivation in the district & followed by Belthangadi 4092 hectares (10.31%), Puttur 2210 hectares (7.55%) Bantwal 500 hectares (10.31%), Puttur 2210 hectares (7.55%), Bantwal 500 hectares (1.78%) and remaining one taluk noticed lowest area under rubber cultivation i.e., 220 hectares (1.005).

Conclusion

Out of the geographical area 33.78% land was under net sown, 26.92% under forest. 2.68% under fallow land, 7.32% under cultivable waste, 12.38% under barren and uncultivable land, 11.84% land put to non-agricultural land, 4.06% permanent pasture other growing land, 6.89% land under miscellaneous trees and growers. Looking at the data of 2000-01, the net sown area has increased very significantly in the year 2010-11. Therefore the land under net sown can be increased. If irrigation facilities are extended still more land can be brought under cultivation. Then available water resources, especially the underground water has to be tapped in order to make dry land agriculture, especially the underground water has to be tapped in order to make dry land agriculture more economical and widely acceptable. Both general land uses should improve in quality and quantity to maintain the related ecology. So that it can help to stop soil erosion and thereby imageries bring certain constraints in the minute and micro land use analysis of the district.

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