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Dynamics Of Urban Landuse/land Cover And Planning For Future Development Of Gokak Town Of Belagavi District, Karnataka

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Abstract

Land is important natural resources and humans, not only live, but also perform economic activities on land. It is also important to have the capability of monitoring the dynamics of land use resulting out of both changing demands of an increasing population and forces of nature acting to shape the landscape. Due to fast urbanization there is variation in natural resources such as water body, agriculture, wasteland land, etc. These environment problems are related to land use and land cover changes and challenges to the sustainable development, but it is mandatory to know the interaction of human activities with the environment and to monitor the change detection. The main objective of this paper are: to asses the land use and land cover changes over a fifteen years of period (1995 – 2011) and to determine the aerial change of land use/land cover data. In this paper an attempt is made to analyze the spatial data of Land use and Land cover of Gokak town. ArcGIS software were used to prepare the Gokak town map based on different decadal data-set with Satellite imagines were utilized in the study for Lu/Lc mapping and change detection. The Lu/Lc classification were used to analyzed based on built-up area with different categories, agriculture area, vacant/open area and water body. The finding shows that patterns of urban growth do not follow Master Plan and even Master Plan deviate profoundly from the preferred land suitability. Of the total area of the conserved, greenbelt, reserved forests and floodplain as per the defined land suitability class, 4.18% of the area has been converted into existing builtup/settlements whereas 46.36% of the total area is proposed under residential settlements, business districts and commercial land use under the Master Plan 2021. It will also create enormous infrastructure and resource crisis in the future, far beyond the capacities of local governments and institutions.

Key Words: *Dynamics, Land Use/Land Cover, Developed Area, Built up area, Planning.*

Introduction:

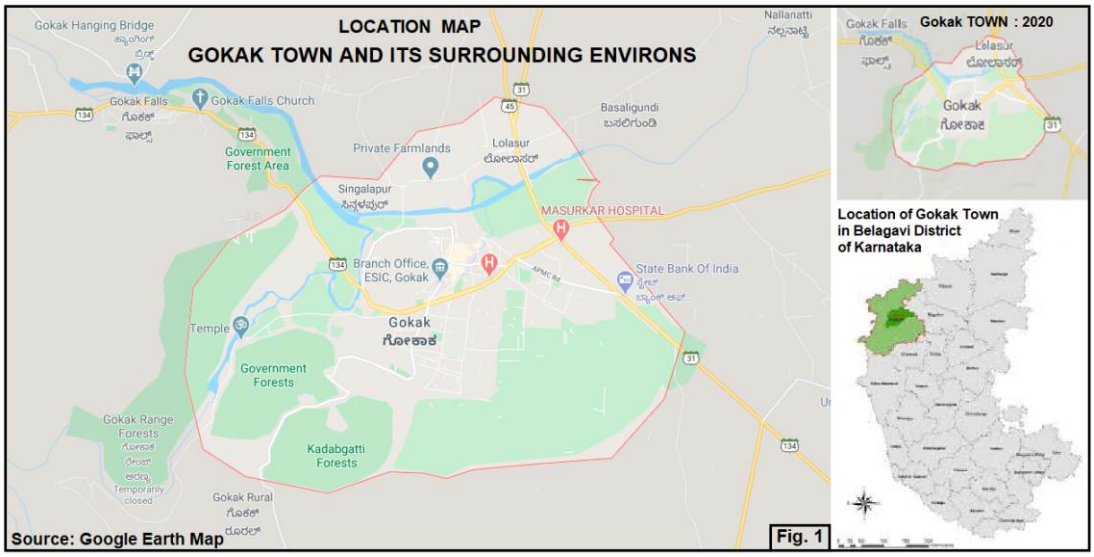
Land is one of the major and most important resources which consist of water, soil, associated with plant and animals involving the total ecosystem. With the rapid increase in population, an activity of human on land resource also has been increasing. For the need of food, energy and many others have to depend on the conservation and development of the productivity of this natural resource. It is also important to have the capability of monitoring the dynamics of land use resulting out of both changing demands of an increasing population and forces of nature acting to shape the landscape. Land is important natural resources and humans, not only live, but also perform economic activities on land. For various purposes land has been used either it may be the provision of shelter, extraction, food production and processing materials. Water and other resources culminate in the development of land use. A sequential development of land use with time results in different land utilization patterns and trends.

Due to diverse man-made and natural processes, lands are in a continuous state of transformation. In urban research, the study of spatial-temporal patterns of intra and interurban form and understanding of the evolution of urban systems are still primary objectives. Land use land cover is often related to environmental problems; therefore, for decision-making in environmental management and future planning land use land cover data are essential input. Due to increasing socio-

economic necessities with increasing population creates an enormous pressure on land use/land cover. These pressure result in uncontrolled and unplanned changes in land use/land cover.1 In recent with the time perceptive of land use/land cover has changed from simplicity to realism and complexity. In earlier studies land use land covers were concerned with the physical aspect of change. Nowadays realizes that land surface processes influence climate because of change in land use land cover. Many researchers have improved measurements of land cover changes from the last few decades. To use land in the most favourable way, it is essential to have knowledge of existing land use land cover. And for better natural resource management it is important to keep updating the land use land cover maps.2 The identification of change in the state of an object at different period/time is one of the processes of land use land cover.3 To monitor and manage natural resource and urban development change detection is an important process because it provides quantitative analysis of the spatial distribution of the population of interest. For monitoring natural resources there are four important aspects of change detection firstly; identification of changes that have occurred, secondly; detection of the nature of change, thirdly; measuring the area of the changes that have occurred and the fourth is assessing the spatial pattern of the changes.4

Study Area:

Gokak town is geographically situated at latitude of 16° 10' north and 74° 53' east longitude at an altitude of 549 mts above mean sea level and it has 2,203 hectors of total municipal area. The town is situated on low land between south bank of river Ghataprabha and range of the hills. The Jat-Jamboti state highway No.31 and major district roads passes through the city and connects the neighboring taluks i.e.: Belagavi, Hukkeri, Chikkodi, Athani, Savadatti, etc. The nearest railway station is Gokak road (near Konnur) at a distance of 12 kms from the existing Gokak town. This town is located at a distance of 65 km from the Belagavi city (district headquarter) and about 565 kms from the Bengaluru city (state headquarter).



The topography of Gokak town is almost plain, but immediately surrounded by hilly areas. The Gokak town has grown at the base of hillock itself. The most of the developments are confined to the west by hillock and to the north by river. There are two rivers flowing in the vicinity of Gokak city, viz Ghataprabha and Markandeya rivers. Forest is totally absent in the region of Gokak. The

surrounding fields of Gokak town have been well irrigated by Ghataprabha river water. The town is categorized as multifunctional one with industries, trade and commerce as primary activities. The town has number of ginning and oil mills, it is a major commercial center in the region. The climate of the town is generally dry, healthy and agreeable. The hot season starts from end of February to the end of May. The monsoon season starts from June to September and cold season starts from October to January. The temperature of Gokak town varies from 37.28°C to 11.35°C. The lowest temperature being in the month of December and highest temperature being in the month of April. The mean maximum temperature is 29.61°C and mean minimum temperature is 21.61°C. The average temperature of Gokak town is comparatively higher than that of surrounding towns. The average annual rainfall of Gokak town is 139mm. The maximum rainfall being recorded during the month of April 2004 with an average of 300mm. For last three years there is no rainfall in this region. The average rainfall of Gokak town is comparatively lower than that of surrounding towns.

Objectives:

The main objective of the present study are:

- to assess the land use and land cover changes over a decade (2001 – 2011)
- to determine the aerial change of land use/land cover data.

Data Collection:

The necessary data-sets for the present study are Urban Maps, Census Data and Satellite imageries.

Primary Data: The Satellite imageries of Landsat-7 and Landsat-8 data-sets over a time period are taken for the present study. Landsat-7 data for the year 1995 and Landsat-8 data for the year 2011 are used and its details are shown in Table:1.

Table:1. Satellite Data-sets Used for the present Study.

Satellite	Date	Resolution	Path	Row
Landsat 7	21-03-1995	30 meters	146	49
Landsat 8	08-03-2011	30 meters	146	49

Secondary Data: Urban maps and census data of Gokak town were collected from Gokak Municipality and town planning office. These data-sets are required for the digitization and delineation of study area.

Methodology:

Land use and land cover maps of Gokak town for 1995 and 2011 are prepared on the basis of two set of satellite imageries retrieved for 1995 and 2011 time periods. Urban maps and census data-sets were also used in the study. Landsat-7 imagery for 1995 and Landsat 8 imagery for the year 2011 were acquired. The preparation of digitized study area maps includes set of operations, with software platforms and datasets. Within the ArcGIS software environment SOI maps of Gokak town has geo-referenced and prepared the land use and land cover maps and also find out the change detection map of study area.

Population Growth:

The population of Gokak town as on 2011 is 79,121, the growth pattern and variation of population in the Gokak town from 1901 to 2011 is given in Table.2. The highest population growth rate has been registered in 1921. During 1901 to 1911 the population of town is decreased -43.13 per cent in a decade and again it increased (1921) drastically up to 74.05 per cant. From 1931 to 1951 the population growth rate is increased and then in 1961 it is decreased to 23.51 per cent. Again from 1971 to 1981 the growth rate is increased to 41.84 per cent and decreased in 1991. From 1991 to 2011 the growth rate again it was increased. Gokak city is the main business center and many of the industries are present, hence to get the work and jobs many of the surrounding villagers are migrated, so the

population of the city is increased.

Table.2.Growth Of Population In Gokak Town (1901-2011).

Census	Population	Percentage of Growth
1901	9,860	--
1911	5,607	-43.13
1921	9,759	74.05
1931	11,478	17.61
1941	13,826	20.46
1951	17,694	27.98
1961	21,854	23.51
1971	29,960	37.09
1981	42,496	41.84
1991	52,080	22.55
2001	67,170	28.97
2011	79,121	17.79

Source: Census of India.

The distribution of population is not even. The part of old town is having higher density whereas the new extension area that is Vivekananda Nagar, Basav Nagar, Laxmi extension, etc. Are the lower density areas. The reason that may be assigned are that there areas are newly and recently developed areas of the city and have still vacant plots and the size of the plots are relatively higher with relatively lower FSI. It is observed from the existing population distribution in 31 wards and the density of population is very high in ward No: 3,4,5,6,7,8,9,11,20,27 and 29 and very low in ward No:1,10,12,13,14,15,16,17,18,19,22,23,30 and 31.

Spatio-temporal Analysis Of Land Use And Land Cover Change:

The spatial structure of the city is the product of competitive interaction between its people market facilities, transportation and communication agencies, type of functions performed in the Gokak town. The functional zones of a town are subject to cultural and physical influences. The influences which the town exerts on the social and economic structure of the areas helps in the formation of land use pattern (see Table.3 and Fig.2).

Table: 3. Existing Land Use Pattern of Gokak Town: 1995 and 2011.

Sl. No	Land Use Type	1995		2011		Area Changes in a decade (1995 to 2011)
		Area (in hect.)	% to the total TMC area	Area (in hect)	% to the total TMC area	
1	Residential	141.28	22.64	185.22	8.40	+43.95
2	Commercial	35.82	5.74	47.48	2.16	+11.66
3	Industrial	43.52	6.97	58.43	2.67	+12.91
4	Public and semipublic	48.43	7.76	60.13	2.72	+11.70
5	Parks ,playground and Public Utility	36.30	5.81	68.83	3.12	+32.53
6	Transport and Communication	52.72	8.45	130.89	5.95	+78.17
	Total Developed Area	**358.07**	**57.37**	**550.98**	**25.01**	**+192.91**
	Water bodies/Nalas	04.68	0.75	4.70	0.23	+0.02
	Vacant land	32.55	5.22	68.45	3.13	+35.90
	Agriculture	228.83	36.66	1,578.87	71.67	+1,350.04
	Grand Total of CMC Area	**624.13***	**100.00**	**2,203.00**	**100.00**	**+1,578.87**

Source: Gokak Town Planning Report. *CMC/Master plan.

Residential Use:

In the present study the area under residential use was occupied large area as compared to other. The total area under residential use in 1995 is 141.28 hectares (22.64%) and it increased to 185.22 hectares (8.40%) in 2011 of the CMC area, which accounts for 33.55 per cent of the total developed area. The maximum number of houses are mainly concentrated in older part of the town, these areas are very thickly concentrated and many houses are built with stone and mud. Most of the new residential developments have come up in the south and eastern part of the town. In this extension areas of Gokak houses are built mostly with bricks, R.C.C. with modern architectural style. The density of population varies from 60 persons per hectare to 180 persons per hectare in the residential area of Gokak town.

Commercial Use:

It is clear from the Table:3 that, the area under commercial use was very less as compared to residential land uses. As it was noticed above, the land use pattern of Indian cities/towns is meant to serve various purposes. Various commercial institutions and their composition and the people engaged in different activities gives the pictures of commercial land use of any urban community. The important commercial areas of the Gokak town named as Central Business District (CBD) area of the city.

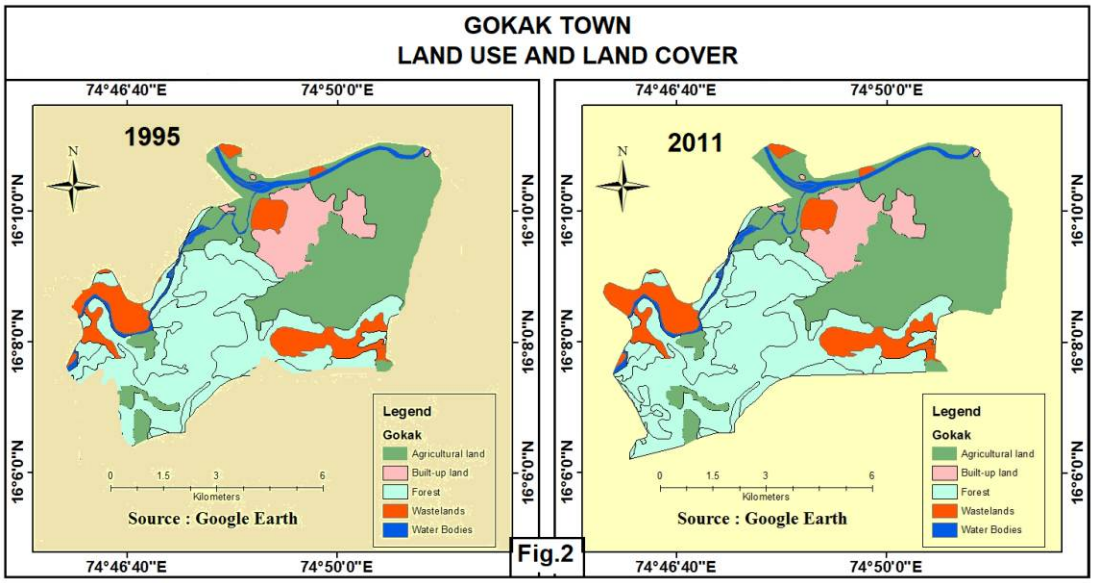


Fig.2

Out of the total CMC (623.13 hectares) area only 35.82 hctares (5.74%) is used for commercial purposes in 1995 and in slightly increase to 47.48 hectares (2.16%) in 2011, the net increase in the period of 15 years is 11.66 hectares and it is considered as well-known commercial town in north Karnataka State, which is 8.71 per cent of the total developed area. As per the existing situation of Gokak town is economically well developed and center part for commercial activities to the surrounding villages. The commercial activities are concentrated in interiors and on either sides of the state highway road. The central business area is located in the old part of town and it is planned part. Apart from this the commercial complexes and shops have come up along the main roads. The APMC yard is located along the Belagavi road is one of the major commercial activity of Gokak town. The main commodities transported are jaggery, groundnut, Maize and Cotton. The weekly market day is Thursday. Five cinema theatres and many of commercial and cooperative banks functions in the

commercial area are located along the both side of 30 mts P.W.D road, Jyoti Peg Bar road, B.Ed. college road, Bus Stand road and APMC road. In this area many commercial buildings have come up.

Industrial Use:

In the present study the industrial area occupy the fourth largest land use in the town. Out of the total CMC area 43.52 hectares (6.97%) in 1995 and it increased to 58.43 hectares (2.67%) of the total CMC area, it net increases in fifteen years were 12.91 hectares. In Gokak town much importance is given to industrial land use in 2011 within the CMC limit, which is 10.70 per cent of the total developed area. Gokak town is quite rich in the agriculture and having a good scope for industrial development especially in agro based industries like cotton, groundnut and maize. These crops are growing in large quantities in surrounding villages. There are old cotton Ginning mills and oil mills in the town. The KIADB has developed an industrial layout in the town. In this layout one of the major industry i.e.Riddhi-Siddhi,Gluco boils limited has set up. The raw material for this industry is maize. KSSIDC has also developed one industrial layout, in which the small industries have come up. Yes Milk Dairy is located near Vivekananda Nagar.

Public and Semi-Public Use:

In the present study the area devoted to public and semipublic use covers an area about 48.43 hectares (7.76%) in 1995 and 60.13 hectares (2.72%) used in 2011, which is the 5th largest area covered in the Gokak town. The net increase for public and semi-public use of land is increased 11.70 hectares in fifteen years of period. The public and semipublic includes Schools, Colleges, Government offices, Hospitals, Temples and other public institutions. heavy concentration in civil area, which is 10.87 per cent of the total developed area. This includes Government Quassi, Government institution, religion and cultural centers. Many of the offices are functioning in private rented buildings. Government offices are facing acute shortages of accommodation. The major share of this public area is occupied under cottage, hospital, J.S.S. College, forest office, T.D.B. office sericulture and GRBC office, mayor school, court and jail, Tahsildar office, Government Junior College, K.L.E. College, Nayak Student Federation, Lakshmi Education Trust and I.B. The Gokak town Government hospital with a strength of about 50 beds. In addition one E.S.I hospital and veterinary hospital located in the town. The numbers of private hospitals, nursing homes are of about 45 numbers in the town.

Parks, Play Grounds and Public Utility:

The existing parks, play grounds and open spaces occupied area of the Gokak town was 36.30 hectares (5.81%) in 1995, it increase to 68.83 hectares (3.12%) in 2011, which is 12.50 per cent of the total developed area. The Walmiki stadium is the major playground under this category. There are no organized parks in the town. The only long space in front of school is used as playground. So far no efforts have been taken by the local authority to develop the park areas provided in the private layouts. The existing public utility use area of the city is the water works near Ghataprabha River, fire station and electric grid near APMC Yard are the major uses come under the public utility services. The solid waste disposal site has been located outside the town limit.

In the Gokak town no separate park area. But in the private layouts the park areas are reserved which are yet to be developed. There is only one public playground in the city by name Walmiki playground. The mayor School, NSF school, L.E.T and J.S.S, New English School have their own play grounds in front of their school and college buildings. The town with a historic background number of temples have located almost in every corner. There are 95 temples in the city. There are 5 theaters in the Gokak city. Nearby Walmiki stadium one Tennis court is run by private club. The Recreational club is situated in the Aditya Nagar. There is GyanyogiPanchakshariGaan Kala Parishat andvaibhavSangama

which provides the cultural activities in the town every month.

Transport and Communication:

The different types of roads and communication utility purpose about 52.72 hectares of areas was used in 1995 and it increase to 130.89 hectares (5.95%) of area is utilized in 2011 to the total CMC area of the Gokak town, which is 23.75 per cent of the total developed area. In recent decade much importance is given to the transport and communication lines development for converting towards to green city concept. The NWKRTC Bus Stand is situated at the core of the town. The lorry parking has been provided in the APMC Yard. The Jat-Jamboti SH 31 and Gokak-Konnur MDR No.11 are the major two roads passing through the city. Most of the internal roads in the town are narrow. This needs the some of improvements far better to traffic movements. There is congestion in the town at every market day (Thursday), because roads are covered by markets. Because internal roads are very narrow. So the traffic congestion takes place at BafanaKhut to ShettyKhut,BafanaKhut to Byali kata, cream corner to Anand Talkies, Apsara hotel to old cattle market. All the problems have been taken care in the preparing the Zonal development District Plans. There are too bad intersections one at Byali Kata another at S.H.3 with the APMC road Junction.

Vacant Land:

The existing vacant land was 32.55 hectares (5.22%) in 1995 and it increased to68.45 hectares (3.13%) of area in 2011, which is 3.13 per cent of the total developed area of the Gokak town . It may gives immense importance in future development of CBD divergent concept for betterment of the urban people. This vacant area in future can be best utilize for residential purpose also. Even though, the rocky hillock located in the central part of the Gokak town.

Water Bodies:

In the Gokak town the area under water bodies and Nalas are about 4.68 hectares of was existed in 1995 and this area is not much changed in 2011 also (4.70 hectares) in the total municipal area. The town has a water supply from the Jackwell provided on the Ghataprabha River. Sufficient water is supplied to the town. Now the K.U.W.S. project is under progress. At present the town has no U.G.D. system. The drainage in the town is mainly through open drains night soil is being collected by the septic tanks. In main parts of the townhead tanks are built for supply the drinking water and other purposes(washing purposes and agricultural).

Agricultural Land:

The Gokak town is located on the Ghataprabha right bank, of rich agriculture zone and the maximum percentage of the Gokak town people engaged in agriculture and its allied activities. As per 1995 census more than 70 per cent of the workers engaged in agricultural and its allied activities. The agriculture area within the town municipal limit was 228.83 hectares (36.66%) in 1995 and it drastically increase to 1,578 hectares (71.67%) in 2011. People of this town depend on agriculture and agriculture based industries such as ginning mill and sugar factories. Most of the workers engaged on cultivation, agriculture labour and house hold industry. At present, available agricultural land in the town is used for raising different crops, mainly jowar, wheat, pulses and vegetables etc.

At present Gokak town is facing several urban problems. The old part of Gokak town is very densely populated and the roads are very narrow. The developments are of a mixed land use. The residential area is covered by commercial industrial areas. The number of Ginning mills and oil mills are running within the heart of city, which creates noise pollution. Also these areas are facing acute shortage of infrastructural facilities like schools with playgrounds, parks and open spaces, wider roads, drainage light and ventilation, etc. The lanes within the town area overcrowded by the traffic and pedestrians. All these problems have been taken care in preparation of master plan.

Peri-urban Interface And Land Use Dynamics:

Peri-urban interface (PUI) is the transitional zone between a sprawling Gokak town periphery and its rural surroundings. Lying between town and villages immediately adjoining the urban area, these extreme peripheries of urban areas suffer from a lack of definition. Yet, in most regions of the world, these areas are expanding rapidly and an increasing number of people are occupying them. As is popularly understood, rural and urban are two broad land use categories, rural areas being dominated by agriculture, horticulture, dairy, etc. whereas, urban areas being primarily occupied by residential, commercial, manufacturing units and other user services. PUI can be perceived as the space between these two categories (urban and rural), marked by interaction of rural and urban forces, resulting in exchange of their individual resources.

Spatial Expansion Of Peri-urban Sites Of Gokak Town:

Within the vast peri-urban area, study focuses on sites located in four suburban areas which differ in their individual demographics and economics, resulting in dissimilar land use mosaics. These four sites are: towards Lolasur village in north-east, along the road towards Mamadapur and Benchinamardi village area on south-east, Kadabagatti village on south-west and along the road of Gokak falls in north and north-west. All the four sites, falling on the periphery of the city contain a mix of rural and urban land use, along with some land uses like quarrying which are particularly associated with PUI and land transformation activities. The LU/LC changes of these test sites were observed from year 1995 to 2011 and relative differences of individual sites were entirely changed, but need to conduct primary survey to analyze the unveil the change pattern and ultimately link these patterns to land transformation process. The change detection analysis reveal that urban land use increased post 1995 in the peri-urban areas over with an average annual rate being 13%. Based on the general observation of the researcher can be supported the major land use transformations marked in rural to urban being 41.91% of total change within the agriculture of Gokak town municipality limit of 2011. Although the allocation of land is governed by competition between urban and agricultural uses, the outcome has increasingly tipped in favor of urban use, leading to substantial spatial growth in peri-urban areas.

The finding shows that patterns of urban growth do not follow Master Plan and even Master Plan deviate profoundly from the preferred land suitability. Of the total area of the conserved, greenbelt, reserved forests and floodplain as per the defined land suitability class, 4.18% of the area has been converted into existing builtup/settlements whereas 46.36% of the total area is proposed under residential settlements, business districts and commercial land use under the Master Plan 2021. Therefore, with the process of urban sprawl in the core and at the peri-urban interface, conserved area such as greenbelt, vacant/open spaces and floodplains are threatened and will be rendered fragile. It will also create enormous infrastructure and resource crisis in the future, far beyond the capacities of governments and institutions. Project outcome would assist planners and land developers to evaluate whether development goals are in agreement with the intended land use objectives and if yes, how the resources should best be used to optimize Gokak town enabling infrastructure and carrying capacity.

Conclusion:

This paper quantitatively explores the spatio-temporal patterns of land use/land cover transformations in the core and along the town periphery of Gokak town, in addition to observing nature and form of urban expansion resulting in a complicated urban landscape. Conflict analysis is carried out to explore disagreements between urban suitability, enabling infrastructure and Master plan 2021 proposed by the Gokak Town Municipal Authority. It is observed that due to rapid economic development, the Gokak town has expanded in size and structure, becoming increasingly

more complex, heterogeneous and irregular in shape. Development has been muddled in peri-urban areas, causing natural and rural land cover to degrade over time and the trend suggests more such degradation in coming years. The land developers tend to be disconnected from the realities of resource limitations and largely inattentive to the long-term impacts of land use modifications. Natural land covers like forest and water bodies are experiencing major deterioration rendering some of the PUI sites as fragile. Each of these impacts is linked to changes in the extent of urban, agricultural and forest lands for development of transportation system, housing and other critical infrastructure systems. This process will continue with time if not checked through proper intervention and strict planning measures and can adversely impact the quality of life of urban and peri-urban dwellers.

Results from urban growth models can be used by land use planners and policy makers to anticipate and plan for future spatial expansion to implementation of "Smart City Concept" in recent years to ensure growth along the lines of city development plans and enabling infrastructure. In order to reduce the negative impacts on environment in future, scientific land use and land cover planning and integrated land management is required for sustainable development within the Gokak town limit. It may aid in quick and useful decisions for the purpose of administration and planning for a sustainable urban environment.

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