J. Farm Sci., 34(3): (283-288) 2021

RESEARCH PAPER

An economic analysis of dynamics of land use pattern in Northern Karnataka

MANJUNATHA P. PALED[1], G. N. KULKARNI[1], V. R. KIRESUR[1], N. M. KERUR[2] AND C. K. VENUGOPAL[3]

[1]Department of Agricultural Economics, [2]Department of Agri-business Management,
[3]Department of Horticulture, College of Agriculture, Dharwad
University of Agricultural Sciences, Dharwad - 580 005, Karnataka, India
E-mail: kulkarnign@uasd.in

(Received: September, 2021 ; Accepted: September, 2021)

Abstract: Land as a primary is an important natural resource for agriculture and supports all forms of economic activities. Hence its utilization to various activities needs to be analysed in order to frame suitable policies related to its optimum use. Therefore the present study was conducted to analyse the growth and dynamics of land use pattern in Haveri and Uttara Kannada districts of Karnataka. The secondary data was collected for a period of 21 years (from 1998-99 to 2018-19) analysed using Compound Annual Growth Rate, Markov chain analysis and other descriptive statistics in order to draw meaningful inferences. Study revealed that in both the districts land put to non-agricultural uses shown a positive significant growth over study period. The cultivable waste, permanent pastures and current fallow have shown significant negative growth in both the districts however, the growth was more rapid in Uttara Kannada district than in Haveri district. In Uttara Kannada Forest area has shown a significant negative growth due to encroachment by people and converted to agricultural land. Interestingly the barren & uncultivable land in Uttara Kannada has shown a dip in its area shows that there is a scope to utilize such land for other productive purposes. Inter-sectoral dynamic analysis revealed that in Uttara Kannada district area under ecological sector decreased by 1020.20 ha per annum. In Haveri district area under non-agricultural sector has increased at a rate of 106 ha per year mainly at the cost of agricultural land. However, in Uttara Kannada area under agricultural sector and non-agricultural sector has increased at loss of ecological sector. Government needs to take necessary measures for reforestation and afforestation through encouragement of agro-forestry and strict action against forest land encroachment so as to protect and improve area under forest cover in the study area.

Key words: Compound annual growth rate, Dynamics of land use pattern, Markov chain analysis

Introduction

The growth and development of an economy is largely influenced by availability and extent of use of natural resources. Land is the mother of all other resources which are used in man's aid. Land is a basic input for agriculture and it occupies an important position among all the resources required for the modern economy (Ramasamy *et al.,* 2005). Being a natural resource, it is subjected to over exploitation leading to degradation. Land use pattern refers to how geographical area of a country is distributed among various economic and non-economic activities. Dynamics with respect to land use is indicated by the changes in the area under different land use categories over time. The land use pattern of a countryat any particular time is determined by the physical, economic and institutional framework taken together. In other words theexisting land use pattern has been evolved as the result of theaction and interaction of various factors such as the physical characteristics of land, institutional framework, the structure of other resources such as capital, labour etc. Though technological progress in agriculture and agricultural intensification have mitigated the ever-increasing demand for land for food production, growing population and the consequent demand for land for non-agricultural purposes are posing a serious challenge to both researchers and policy makers (Ramasamy *et al.,* 2005).

Haveri and Uttara Kannada districts have geographical area of 4,85,156 ha and 10,24,679 ha respectively. During 2018-19, in Haveri district more than three fourth of the geographical area (3,74,548 ha) was utilized for cultivation purposes (net sown area) which is more than state as a whole (55.85%), 9.78 per cent was occupied by forest area (47,545 ha) and 6.91 per cent put to non-agricultural uses (33,515 ha). Contrastingly in Uttara Kannada district nearly 80 per cent was occupied by forest (8,13,595 ha), only 12.45 per cent of the land was put under cultivation (net sown area) (1,27,545 ha) and 3.39 per cent put to non-agricultural uses (34,713 ha).The average size of land holding in India is just 1.1 ha and it has been declining over time causing concern of food and livelihood security of millions of smallholders. As the supply of land is fixed, the pathway to increase agricultural production and improve farmers' livelihood is possible only by improving productivity and efficiency of land in a sustainable manner (Pandey and Ranganathan, 2018).

There have been many studies conducted on dynamics of land use pattern at the national and state level (Samaya, 2011; Adhikari and Sekhon, 2014; Sinha, 2017 and Pandey, 2018) and there are few studies which have analysed such type of land use dynamics at district level (Tirlapur and Mundinamani, 2015 and Gaikwad *et al*., 2018 *etc.*). However no such studies have been conducted recently on this aspect in Haveri and Uttara Kannada districts which have altogether distinct agro climatic situations and land use pattern.Hence the study was undertaken to analyse the land usepattern in Haveri and Uttara Kannada districts with objective to study the growth in different land use categories and to analyse the dynamics of land use pattern and to predict the future share of different land use categories to total geographical area of both the districts.

Material and methods

Data and source

The present study on analysis of land-use dynamics is conducted in Haveri and Uttara Kannada districts of Northern Karnataka which represent northern transitional and hilly zones of Karnataka. The study is based on time series secondary data for a period of 21 years (1998-99 to 2018-19) collected from the Directorate of Economics and Statistics (DES), Government of Karnataka.

Analytical tools

Markov Chain Analysis

Shift in land use pattern was analyzed using the firstorder Markov chain approach. Central to Markov chain analysis is the estimation of the transitional probability matrix (P). The elements P_{ij} of the matrix P indicates the probability that area under different uses will switch from one pattern (i^{th}) to another (j^{th}) with the passage of time. In the context of the current application, from 1998-99 to 2018-19; nine types of land uses were merged into five major forms of landutilization based on similarities to make it convenient considering the requirement of the tool.

$$E_{jt} = \Sigma E_{it-1} P_{ij} + e_{jt}$$

i=1…5

Where,

E_{jt}= Area under forest to j^{th} purpose during the year t.

E_{it-1} = Area under ith purpose during the period t-1

P_{ij} = Probability that the area will shift from i^{th} purpose to j^{th} purpose.

e_{jt} = The error term which is statistically independent to E_{it-1}.

t = Number of years considered for the analysis

i = Number of purpose for which land is used

Compound Annual Growth Rate (CAGR)

Growth of any variable indicates its past performance. The analysis of growth is usually used in economic studies to find out the trend of a particular variable over a period of time. It clearly indicates the performance of the variable under consideration and hence it can be very well used for making interpretations and to evolve policy decisions. The growth in the area under different land use categories was estimated using the exponential growth function of the form

$$Y_t = AB^t V_t \ldots (1)$$

Where,

Y_t = Area under different land use categories in the year t

A = Intercept indicating Y in the base period (t = 0)

B = 1 + g

t= time period

V_t= Random disturbance term

Equation (1) was converted into the logarithmic form as follows to make it in a linear form:

$$\ln Yt = \ln A + t * \ln B + \ln V_t$$

This is of the following form

$$Qt = a + bt + U_t \ldots\ldots (2)$$

Where,

$Qt = \ln Y$

$a = \ln A$

$b = \ln B$

$Ut = \ln V_t$

The values of 'a' and 'b' were estimated by using Ordinary Least Squares estimation technique. Later, the original 'A' and 'B' parameters in equation (1) were obtained by taking antilogarithms of 'a' and 'b' values as;

A = Antilog (a) and

B = Antilog (b)

Average annual compound growth rate (%) was calculated using the formula:

$$g = (B - 1) * 100$$

Results and discussion

Status and change in land use pattern

The land use pattern is subject to changes over time due to both human and non-human forces. These changes in land utilization are a long term phenomenon. It is most important from the point of view of nation as well as individuals and to assess the extent and direction towards which these changes are moving.

The status and change in land use pattern in Haveri district is presented in Table 1. It is evident from the table that total geographical area is 4,85,156 ha. During 1998-99, out of total geographical area, 3,60,680 ha (74.34%) land was utilized for cultivation purposes (net sown area) which is nearly three fourth of the geographical area. The next highest area was occupied by forest land *i.e.,* 47,454 ha (9.78%) which is less than the minimum proportionate area (33% of the geographical area) required to maintain ecological balance, 6.47 per cent put to non agricultural uses, 3.58 per cent occupied by current fallow and about three per cent by permanent pastures and trees and grooves together. It could be seen that there has been a considerable change in the land usage pattern during the study period (from 1998-99 to 2018-19). The proportion of land under cultivation has increased by 3.84 per cent (3,74,548 ha). The most alarming fact is that land utilized for non-agricultural uses has increased by 6.75 per cent. During the same period there was a substantial decrease in current fallow (74.07%), area under other fallow (62.03%) and cultivable wastes (4.78%). The main reasons for this might be growth in demand for food stuffs on account of unprecedented population, migration of rural people to urban areas leading to urbanization, industrialization,

Table 1. Changes in land use pattern in Haveri district (1998-99 and 2018-19) (Area in ha)

Land use categories	1998-99	% of TGA	2018-19	% of TGA	% Δ from 1998-99 to 2018-19
Forest	47,454	9.78	47,454	9.78	0
Non-Agricultural uses	31,395	6.47	33,515	6.91	6.75
Barren & Uncultivable land	5793	1.19	5793	1.19	0
Cultivable waste	3139	0.65	2989	0.62	-4.78
Permanent pastures	12,526	2.58	12,209	2.52	-2.53
Trees & Grooves	1919	0.40	2290	0.47	19.33
Current fallow	17,367	3.58	4504	0.93	-74.07
Other than current fallow	4883	1.01	1854	0.38	-62.03
Net Sown Area	3,60,680	74.34	3,74,548	77.20	3.84
Total Geographical Area	4,85,156	100.0	4,85,156	100.0	0

Source: Directorate of Economics and Statistics, Karnataka and author's estimation

construction of roads, railway lines and other infrastructure developmental activities etc. Due to forest conservation measure taken by the government the area under forest has remained unchanged but the density of forest is the most critical thing along with forest area that affects the ecological balance.

The status and change in land use pattern in Uttara Kannada district is presented in Table 2. It is evident that out of 10,24,679 ha of geographical area during 1998-99, about 8,15,057 ha areawas occupied by forest (79.54%). Only 1,10,951 ha (10.83%) land was utilized for cultivation purposes (net sown area). The area occupied by non-agricultural uses was 30,188 ha (2.95%) and fallow land was about 1.50 per cent. Here also there has been a considerable change in the land usage pattern over time. During the period from 1998-99 to 2018-19, there was a marginal decrease in area under forest by 0.18 per cent. The proportion of land used for cultivation has increased by 14.96 per cent (1,27,545 ha). The area under non-agricultural uses has increased by more than 4000 ha (14.99 %). The area under current fallow has decreased substantially by 28.34 per cent. Siwana *et al.* (2018) found a contrasting result where current fallow and other fallow have increased by 0.40 and 0.24 per cent, respectively. A good sign is that the area under barren and uncultivable land and cultivable waste has decreased respectively by 17.48 per cent and 18.34 per cent over the same period. The possible reasons for this change might be conversion of cultivable waste land to agricultural and non-agricultural uses. However, the area under permanent pasture and trees & grooves has decreased by 65.8 per cent and 53.94 per cent respectively.

Growth in land use categories

The way to study the long term growth in different land use categories is to estimate the compound annual growth rate (CAGR). The growth in area under different land use categories in Haveri and Uttara Kannada district is given in Table 3. It is evident from the results that land under non agricultural uses has increased significantly in both the districts by 0.4099 and 0.5102 per cent respectively. Similar findings were reported by Gulave *et al.* (2018) where land put to non-agricultural uses increased by 31.90 per cent over a period from 1986-87 to 2015-16. Permanent pasture has recorded a significant negative growth in both the districts by 0.122 and 2.196 per cent, respectively. Cultivable waste land has also decreased significantly in both the districts by 0.1211 and 1.099 per cent, respectively. In Haveri district the forest land and barren and uncultivable land have shown no growth whereas in Uttara Kannada district same have shown significant decline by 0.0092 and 0.6819 per cent, respectively.The current fallow in both the districts has recorded a significant negative growth by 3.9745 and 1.2241 per cent respectively. But study conducted by Sinha *et al.* (2017) in Bihar state found a contrasting result where current fallow has shown a positive growth.The net sown area is found to be increasing but at an insignificant rate in both districts. The similar results such as declining cultivable waste, declining current fallow and insignificant growth in net sown area were obtained by Adhikari and Sekhon (2014) in Punjab. The decreasing forest area in Uttara Kannada district might be due to housing construction and generating the new crop lands

Table 2. Changes in land use pattern in Uttara Kannada district (1998-99 to 2018-19) (Area in ha)

Land use categories	1998-99	% of TGA	2018-19	% of TGA	% " from 1998-99 to 2018-19
Forest	8,15,057	79.54	8,13,595	79.40	-0.18
Non-Agricultural uses	30,188	2.95	34,713	3.39	14.99
Barren & Uncultivable land	19,626	1.92	16,196	1.58	-17.48
Cultivable waste	7899	0.77	6450	0.63	-18.34
Permanent pastures	19,676	1.92	6730	0.66	-65.8
Trees & Grooves	4757	0.46	2191	0.21	-53.94
Current fallow	8298	0.81	5946	0.58	-28.34
Other than current fallow	8227	0.80	11,313	1.10	37.51
Net Sown Area	1,10,951	10.83	1,27,545	12.45	14.96
Total Geographical Area	10,24,679	100.0	10,24,679	100.0	0

Source: Directorate of Economics and Statistics, Karnataka and author's estimation

Table 3. Growth rates of land use categories in the study areas (1998-99 to 2018-19) (Per cent per year)

Land use categories	Haveri	Uttara Kannada
Forest	0.00	-0.0092**
Non-Agricultural uses	0.4099**	0.5102**
Barren & Uncultivable land	0.00	-0.6819**
Cultivable waste	-0.1211*	-1.0990**
Permanent pastures	-0.1220**	-2.1960**
Trees & Grooves	1.22**	-0.8319
Current fallow	-3.9745**	-1.2241*
Other than current fallow	0.6132	2.4637**
Net Sown Area	0.1076	0.2316

Source: Author's estimation

Note: * and ** indicate the significance at 1 per cent and 5 per cent probability levelrespectively

to support the increasing demands of the growing population and implementation of various developmental projects such as hydroelectric projects in the district as indicated by Kuchay and Ramachandra (2016).

Transitional probability matrix for land use categories

With fixed geographical area, land put to different uses subject to changes among themselves over time. This type of transition can be captured with some probabilities using Markov chain analysis in the form of matrix. For convenience nine fold land use classes were merged into five meaningful classes based on relevancy. The diagonal elements of the probability matrix indicate the probability of retention of its share by the corresponding land use and elements except the diagonal elements in rows and columns respectively present the probability of loss to and gain by the corresponding land uses.

Transitional probability matrix of land use categories in Haveri district is presented in Table 4. It is clear from the table that area under forest, land not available for cultivation and net sown area were the most stable land use classes as it is evident from higher transitional probability values of 1.00, 0.9659 and 0.9648 respectively. Land under fallow was the most unstable land use class with transitional probability value of 0.2993. The forest land has neither gained nor lost its area.The probability that land not available for cultivation lost its area to other uncultivated land excluding fallow land is 0.034. The fallow land being the most unstable land use class lost its area to net sown area with probability of 0.6813 and probability that it gained from Other uncultivated land excluding fallow land is 0.5749. The net sown area gained most of the area from fallow land with probability of 0.6813 and lost a meagre area to land not available for cultivation, other uncultivated land excluding fallow land and fallow land.

Transitional probability matrix of land use categories in Uttara Kannada district is presented in Table 5. It is clear from the table that all the land use classes were likely to be stable with higher transitional probability values. The probability that forest land retained its area was found to be 0.9904. The probability that it gained from fallow land is 0.0573 and from net sown area is 0.0596 and probability of losing to land not available for cultivation is 0.0964. The probability that land not available for cultivation retained its area from previous period is 0.8241. Its probability of loss to net sown area is 0.169 and that of gain is 0.0964 from forest and 0.014 from fallow land. The probability that other uncultivated land excluding fallow land retained its previous share by 0.9874 and the probability of loss to land not available for cultivation is 0.0125. The probability of retention of fallow land was found to be 0.7816 and probability that it gained from net sown area is 0.0395 and that of loss are 0.1471 to net sown area and 0.0573 to forest land. Net sown area has the probability of retention of 0.8967. The probabilities of gain are 0.169 from land not available for cultivation and 0.1471 from fallow land.

Projected shares of land use categories

With the help of transitional probability matrix one can forecast probable future values of different land use classification which will be useful for policy makers to take proper measures to have control on the shift in these land use pattern.The shares of different land use categories were predicted for four years (2019-20 to 2022-23).

The results pertaining to Haveri district is presented in table 6. It is can be observed that forest area, land not available for cultivation and Other uncultivated land excluding fallow land are likely to retain their share in future. The main reason for constancy of share ofland not available for cultivation is conversion of other types of land such as cultivable waste, fallow land, pasture land and agricultural land for residential plots and construction factories *etc.* While share of fallow land

Table 4. Transitional probability matrix for land use categories in Haveri district (1998-99 to 2018-19)

Land use category	Forest	Land not available for cultivation	Other uncultivated land excluding fallow land	Fallow land	Net sown area
Forest	1.00	0.00	0.00	0.00	0.00
Land not available for cultivation	0.00	0.9659	0.0340	0.00	0.00
Other uncultivated land excluding fallow land	0.00	0.00	0.4250	0.5749	0.00
Fallow land	0.00	0.00	0.0192	0.2993	0.6813
Net sown area	0.00	0.0037	0.0230	0.0084	0.9648

Source: Author's estimation

Note: Land not available for cultivation included a) Land put to non-agricultural uses b) Barren and uncultivable lands;

Other uncultivated land excluding fallow land included a) Permanent pastures and other grazing lands b) Land under miscellaneous tree crops and groves c) Cultivable wastes;

Fallow land included a) Current fallows b) Fallows other than current fallow

Table 5. Transitional probability matrix for land use categories in Uttara Kannada district (1998-99 to 2018-19)

Land use category	Forest	Land not available for cultivation	Other uncultivated land excluding fallow land	Fallow land	Net sown area
Forest	0.9904	0.0964	0.00	0.00	0.00
Land not available for cultivation	0.00	0.8241	0.0068	0.00	0.1690
Other uncultivated land excluding fallow land	0.00	0.0125	0.9874	0.00	0.00
Fallow land	0.0573	0.0140	0.00	0.7816	0.1471
Net sown area	0.0596	0.0041	0.00	0.0395	0.8967

Source: Author's estimation

Table 6. Projected shares of land use categories in Haveri district (Area in ha)

Land use category	Forest	Land not available for cultivation	Other uncultivated land excluding fallow land	Fallow land	Net sown area
2019-20	9.78	8.12	3.60	3.64	74.86
2020-21	9.78	8.12	3.60	3.79	74.71
2021-22	9.78	8.12	3.60	3.83	74.67
2022-23	9.79	8.12	3.60	3.84	74.66

Source: Author's estimation

might increase from 3.64 per cent to 3.84 per cent and share of net sown area is likely to decrease because of erratic rainfall in the district leading fallow land to increase. Adhikari and Sekhon (2014) obtained some contrasting results where they found that in Punjab share of land not available for cultivation was likely to decrease; share of fallow land was likely to remain same and increasing share of net sown area in near future.

The results pertaining to Uttara Kannada district is presented in Table 7. The results revealed that forest area is likely to lose its substantial share from 69.91 to 59.72 per cent. Whereas the remaining land use categories are likely to increase their share in future. The land not available for cultivation, other uncultivated land excluding fallow land, fallow land and net sown area are likely to increase their share in future to 21.80 per cent, 1.46 per cent, 1.77 per cent and 15.25 per cent respectively. While the share of fallow land is likely to increase due to erratic rainfall in the district and share of net sown area is likely to increase because of encroachment of forest land by local community to convert as agricultural land. The availability of irrigation water throughout the year also helps the people to take up perennial crops.

Intra-sectoral dynamics of land use pattern

Based on the similarities again we can classify different land use categories further into three sectors namely non-agricultural sector comprising of Land put to Non-agricultural uses, ecological sector comprising of forest, permanent pastures and other grazing lands, land under miscellaneous tree crops & groves and barren & uncultivable land and agricultural sector comprising of cultivable wastes, fallows other than current fallow, current fallows and net area sown.The results of annual rate of inter sectoral dynamics for a period 1998-99 to 2018-19 is presented in Table 8.

In Haveri district during the study period, non agricultural sector comprising of land put to non agricultural uses increased by 106 ha per annum. In ecological sector forest land and barren & uncultivable land have registered no change in their area. Whereas area under permanent pastures and other grazing lands has decreased by 15.85 ha per year and land under miscellaneous tree crops and groves has increased its area by 18.55 ha per year. Under agricultural sector cultivable wastes, fallow other than current fallow, current fallow have decreased by 7.5 ha, 151.45 ha and 643.15 ha per annum, respectively whereas net sown are has increased by 693.40 ha per year.

In Uttara Kannada district, non agricultural sector comprising of land put to non agricultural uses increased by 226.25 ha per annum. In ecological sector all sub sectors such as forest land, permanent pastures & other grazing lands and miscellaneous tree crops & groves and barren & uncultivable land have registered loss in their area by 73.10 ha, 647.3 ha, 128.30 ha and 171.50 ha per annum, respectively. Under agricultural sector cultivable wastes and current fallow have decreased by 72.45 ha, 117.60 ha per annum, respectively whereas fallows other than current fallow and net sown are have increased by 154.30 ha and 829.70 ha per year.

Table 7. Projected shares of land use categoriesin Uttara Kannada district (Area in ha)

Land use category	Forest	Land not available for cultivation	Other uncultivated land excluding fallow land	Fallow land	Net sown area
2019-20	69.91	15.39	1.39	1.67	11.65
2020-21	66.02	18.40	1.39	1.66	12.53
2021-22	62.64	20.45	1.41	1.70	13.80
2022-23	59.72	21.80	1.46	1.77	15.25

Source: Author's estimation

Table 8. Intra-sectoral dynamics of land use pattern (1998-99 to 2018-19)

	Annual rate of change (in ha)	
Land use sector	Haveri	Uttara Kannada
I. Non-agricultural sector		
a. Land put to non agricultural uses	106	226.25
II. Ecological sector		
a. Forest	0	-73.10
b. Permanent pastures and other grazing lands	-15.85	-647.30
c. Land under miscellaneous tree crops and groves	18.55	-128.30
d. Barren and Uncultivable land	0	-171.50
III. Agricultural sector		
a. Cultivable wastes	-7.5	-72.45
b. Fallows other than current fallow	-151.45	154.30
c. Current fallow	-643.15	-117.60
d. Net area sown	693.40	829.70

Source: Author's estimation

Inter-sectoral dynamics of land-use pattern

Sector wise annual change in land use pattern is presented in Table 9. Ecological sector is further classified into desirable ecological sector and undesirable ecological sector. In Haveri district, ecological sector has increased by 2.70 ha per year because of rise in area under desirable ecological sector by cent per cent and undesirable ecological sector retained its area over the study period. Agricultural sector has decreased by 108.70 ha per annum and non agricultural sector has increased by 106 ha per year. In Uttara Kannada district, ecological sector has decreased by 1020.20 ha per year in that the desirable ecological sector has decreased by 848.70 ha per annum and undesirable ecological sector decreased by 171.50 ha per year. Agricultural sector has increased by 793.95 ha per annum and non agricultural sector has also increased by 226.25 ha per year.

Table 9. Inter-sectoral dynamics of land-use pattern (1998-99 to 2018-19)

	Annual rate of change (in ha)	
Land use sector	Haveri	Uttara Kannada
I. Ecological sector ($\Delta E = \Delta E1 + \Delta E2$)	2.70	-1020.20
a. Desirable ecological sector ($\Delta E1$)	2.70	-848.70
b. Undesirable ecological sector ($\Delta E2$)	0.00	-171.50
II. Agricultural sector (ΔA)	-108.70	793.95
III. Non-agricultural sector (ΔN)	106	226.25

Source: Author's estimation

Conclusion

In Haveri district at present only 9.78 per cent of the geographical area is under forest which is less than the state average. Compound annual growth analysis indicated that land put to non agricultural uses is increasing significantly in both the districts. But growth is more rapid in Uttara Kannada compared to Haveri district althoughthe population density is less than the latter. The forest area in Uttara Kannada district has shown a significant negative growth. The good sign is that barren & uncultivable land in Uttara Kannada and cultivable waste land in both districts have shown a declining trend which can be utilized for agriculture and non agricultural purposes so that pressure on agricultural land can be minimized. Though compound growth analysis has shown a negative trend in current fallow but the prediction has shown that the area under current fallow is likely to increase in the future. So government needs to take effective measures to extend irrigation facilities to areas where erratic rainfall has been an issue so as to reduce fallow land and also measure needs to be taken on reforestation and afforestation through encouragement of agro-forestry and strict action against forest land encroachment so as to protect and improve forest cover.

References

Adhikari A and Sekhon M K, 2014, An economic analysis of land use dynamics in Punjab. *International Journal of Advanced Research*, 2(5): 551-560.

Anonymous, 2020, Karnataka at a Glance, 1999-2000 to 2019-20, Directorate of Economics and Statistics, Government of Karnataka.

Gaikwad R A, Deshmukh K V and Shelke R D, 2018, Land Utilization and Cropping Pattern in Beed District of Maharashtra. *International Journal of Current Microbiology and Applied Sciences,* 7(10): 2094-2100.

Gulave C M, Pokharkar V G and Kshirsagar A V, 2018, Land use dynamics in Maharashtra, *Contemporary Research in India*. 8 (4): 1-7.

Kuchay S A and Ramachandra T V, 2016, Land Use Land Cover Change Analysis of Uttara Kannada. *Imperial Journal of Interdisciplinary Research* (IJIR), 2(4): 460-471.

Pandey G and Ranganathan T, 2018, Changing land-use pattern in India: has there been an expansion of fallow lands?, *Agricultural Economics Research Review*. 31 (1):113-122.

Ramasamy C, Balasubramanian R and Sivakumar D, 2005, Dynamics of land use pattern with special reference to fallow lands-An empirical investigation in Tamil Nadu. *Indian Journal of Agricultural Economics*, 60 (4): 629-644.

Samaya G, 2011, Land use dynamics in Karnataka-an economic analysis, *M. Sc. (Agri.) Thesis*, University of Agricultural Sciences, Dharwad, Karnataka.

Sinha D K, Ahmad N and Singh K M, 2017, Shrinking Net Sown Area and Changing Land Use Pattern in Bihar: An Economic Analysis. *MPRA*, Paper No. 80268.

Siwana H, Koshta A K and Pathak H, 2018, Dynamics of Land Use Pattern in Bastar Plateau of Chhattisgarh: A Temporal and Spatial Analysis, *International Journal of Agricultural Science and Research,* 8(4):43-48.

Tirlapur L N and Mundinamani S M, 2015, An economic analysis on land use and cropping pattern in Dharwad district. *International Research Journal of Agricultural Economics and Statistics*, 6(1):176-181.