J. Indian Soc. Coastal Agric. Res. 41(2): 94-99 (2023) https://doi.org/10.54894/JISCAR.41.2.2023.141847

Assessment of Changes in Land Use Pattern in South Gujarat Region

D.J. CHAUDHARI* and A.K. LEUA

Department of Social Science, ASPEE College of Horticulture & Forestry,
Navsari Agricultural University, Navsari - 396 450, Gujarat, India

Received: 04.09.2023 Accepted: 14.12.2023

The quantity of production of any specific crop mainly depends on its productivity and the land quality of the cropped area. The land in the South Gujarat region including four coastal districts is 12.24% of the total geographical area of the state. The present investigation was carried out to study the inter-sectoral land use dynamics and pattern of distribution of the particular classes of land across South Gujarat. The study is based on secondary data from 2000-01 to 2019-20 collected from the different publications of the Government. Analysis of data was done by using a simple identity of linearly additive land use changes model and location coefficient. The barren and uncultivable land, forest land and land under miscellaneous tree crops and groves declined whereas land area under current fallow land, non-agriculture and permanent pasture and grazing raised in South Gujarat during the study period. The land area under forest and land under miscellaneous tree crops and groves shifted towards agricultural land or land for non-agriculture activities or both over the study period in South Gujarat. The unfavourable shift in land use in the desirable ecological sector and a favourable shift in land use in the undesirable ecological sector were observed in South Gujarat. The land area under the agricultural sector annually increased by 92106 ha which was at the cost of the desirable ecological sector. The location coefficient for the area under forest, the area under non-agricultural uses and the net sown area was higher during the study period indicating that there was a higher concentration of these categories of land in South Gujarat. The location coefficient of current fallow land indicated a sharp increase in the area under fallow land during the study period, implying that suitable interventions are needed to bring this area under cultivation to increase agricultural production.

(***Key words:*** *Inter-sectoral shift, Land use, Location coefficient, Rate of change*)

Land is a vital resource for agriculture sector. The size of the land is fixed and cannot be expanded to meet the demand of the increasing population. Therefore, it should be used as more as possible. The increasing population is putting pressure on land. The population of India will be 1.4 billion in 2025 (Mari Bhat, 2022). India has a total geographical area of 32.88 lakh km^2 which is about 2.4% of the area of the world's land. According to the Ministry of Rural Development, Government of India, the per capita availability of land in the world is 0.29 ha, whereas the per capita availability of land in India is 0.12 ha. The development of different sectors depends on the availability of land. Land is not only a crucial factor in the economic development of a country but also plays a significant role in maintaining environmental health and ecological balance. The land has some particular characteristics like inelastic in supply, immobile and perishable in nature, due to which it gains prime importance in factors of production (Raju and Rao, 2009).

The land use pattern is always affected by different factors which include the socio-economic, agro-climatic, ecological, institutional and climatic factors. The change in technology also affects the land use pattern. Different studies showed that there has been a shift in land use from desirable ecology towards undesirable ecology in agricultural and non-agricultural sectors. Shift in land use from the agriculture sector towards undesirable ecology may cause serious implications on agricultural development and thereby reduce food production. The shifting of land from desirable ecology to non-agriculture use may disturb the ecological balance which ultimately affects climatic factors (Samaya *et al.,* 2011). Thus the disturbance in land use pattern may badly affect ecology and agriculture which have consequences on food security.

The total geographical area of the Gujarat state is

**Corresponding author:* E-mail: djecon@nau.in

1.96 lakh km^2 and the South Gujarat region occupies 12.24% of the total geographical area of the state. South Gujarat region has seven districts among which four districts fall under the coastal belt. The climatic condition of South Gujarat region is suitable for different agriculture and horticulture crops. South Gujarat is dominant in industries like textile, diamond polishing, chemical, petrochemical, pharmaceuticals and plastic industry. This region has four ports and five Special Economic Zones (SEZs) which promote the industrial and other infrastructural development in the region. Southern Gujarat contributes more than 50% share of Micro Small and Medium sized Enterprises (MSME, 2015). The four coastal districts of south Gujarat are well connected by national highways and railways. Thus, the land in this region is used for different activities like agriculture, industries, forests and other infrastructural facilities. It is necessary to know the dynamics of present land use systems and their ecological implications in the South Gujarat region. An analysis of changes in the land use pattern over a period of time provides scope for planned and judicious management of land. Therefore the present investigation was undertaken to study the inter-sectoral land use dynamics and identify the pattern of distribution of the particular classes of land across different districts of South Gujarat.

MATERIALS AND METHODS

The present investigation was based on secondary data pertaining to the different land use classes in South Gujarat. Based on availability, the data on land use classes were collected from the different publications of the Government of Gujarat like Gujarat State Forest reports, the website of the Directorate of Economics and Statistics, Government of India, etc., for 20 years period from 2000-01 to 2019-20.

Land use dynamics

The inter-sectorial shift in land use dynamics was examined by using a simple identity of linearly additive land use changes. This methodology was described by Pandey and Tewari (1987) which was further used by Amale and Shiyani (2019), Bardhan and Tewari (2010) and Sharma and Pandey (1992). The first accounting identity linearly summed up the area under all land-use classes which was equal to the total reported area, given by Eq. 1.

$$R = F_r + P + M + N + U + W + F_c + F_o + C \quad \ldots 1$$

where, R = Total reporting area, F_r = Area under forest, P = Area under permanent pastures, M = Area under miscellaneous tree crops and groves, N = Area under non-agricultural uses, U= Barren and uncultivated land, W = Cultivable wasteland, F_c = Current fallows, F_o = Fallows other than current fallow, C = Net area cultivated.

The change in the total reporting area is given by

$$\Delta R = \Delta F_r + \Delta P + \Delta M + \Delta N + \Delta U + \Delta W + \Delta F_c + \Delta F_o + \Delta C \quad \ldots 2$$

where, Δ indicates the change in a particular class of land.

The total land endowment can be conveniently grouped into three broad sectors, *viz.*, (i) ecological sector (E) comprising F_r, P, M and U, (ii) agricultural sector (A) comprising W, C, F_c and F_o and (iii) non-agricultural (NA) sector. The ecological sector was further divided into two sub-sectors, *viz.*, (i) the desirable ecology (E_1) comprising F_r, P and M, and (ii) undesirable ecology (E_2) comprising U. Then, the net changes within each sector can be budgeted as:

$$\Delta E = \Delta E_1 + \Delta E_2 = (\Delta F_r + \Delta P + \Delta M) + (\Delta U) \quad \ldots 3$$

$$\Delta A = \Delta F_c + \Delta F_o + \Delta W + \Delta C \quad \ldots 4$$

$$\Delta R = \Delta E_1 + \Delta E_2 + \Delta A + \Delta N \quad \ldots 5$$

For finding the annual rate of change in various land use classes, linear time trend equations were estimated on the land use time series for the state. The annual rates of change in different classes were worked out using Eqs. 3, 4 and 5 which facilitate the analysis of the direction of land use shifts and their dynamics. The possible land use shift within the ecological sector may occur as follows. The land use shifts from M and P to F_r which has no adverse ecological implications. The shift from F_r to P, which may possibly occur in some hills, does have some adverse implications. The shift from U to F_r has favourable ecological consequences. However, the shift from F_r and M to U will have serious adverse ecological effects.

Location coefficient

The pattern of distribution of the particular category of land across South Gujarat was examined by using the location coefficient. Nasim *et al.* (2018), Pandey and

Ranganathan (2018) and Ramasamy *et al.* (2005), in their studies used the location coefficient to examine the concentration of a particular category of land. A higher value for the location coefficient for a district or region indicates the higher concentration of that particular category of land in the region. Location co-efficient (L) was estimated as:

$$L = (L_{ij}/L_i) / (L_i/L_s) \quad ...6$$

where, L_{ij} = area of j^{th} category of land in i^{th} district/ region, L_i = area of all categories of land in the district/ region, L_j= area of j^{th} categories of land in the state and L_s= area of all categories of land in the state.

RESULTS AND DISCUSSION

Percentage change in land use

Percentage change in different land use classes in South Gujarat during the period of 20 years *i.e.*, from 2000-01 to 2019-20 is given in Table 1. It was observed that the land area in most of the land classes declined over the study period. The total reporting area of land was 23.25 lakh ha during 2000-01 which declined by 1.06% and reached up to 23.00 lakh ha during 2019-20. The highest decline in land area was recorded in barren and uncultivable land (42.93%), followed by forest (30.24%), land under miscellaneous tree crops and groves (30.00%) and cultivable wasteland (1.69%). The land area under current fallow increased substantially (77.23%) which was followed by the area under non-agriculture (21.85%) and permanent pasture and grazing land (18.87%). The net sown area in South Gujarat recorded less growth (6.63%) during the study period.

Annual rate of change in land use classes

The intra-sectoral dynamics in land use presented by the annual rate of change is given in Table 2. It was found that the shift in land use classes took place from forest, barren and uncultivable land and land under miscellaneous tree crops and groves to the other categories of land over the study period in South Gujarat. The land under forest and miscellaneous tree crops and groves declined annually by 143055 ha and 986 ha, respectively which indicated that the area of these categories of land diverted to other sectors in South Gujarat (Fig. 1). Amale and Shiyani (2019) reported the similar results in their study on ecological implications of land use dynamics in Gujarat. Bardhan and Tewari (2010) found that the forest land in Gujarat state declined since 1992-93. The barren and uncultivable land recorded a decline in the area at the annual rate of 33898 ha. As the barren and uncultivable land cannot be used for agricultural purposes, it may be diverted towards non-agriculture activities. The area under permanent pasture and grazing land annually increased by 8126 ha during the study period indicating that the land area may have shifted from forest towards permanent pasture and grazing which may cause adverse implications on climatic conditions.

The net sown area, current fallow land, other fallow

Table 1. *Percentage change in land use classes in South Gujarat*

	(Area in Lakh ha)		
Land use classes	2000-01	2019-20	% change
Reporting area	23.25	23.00	-1.06
Forest	5.73	4.00	-30.24
Area under non-agriculture	2.37	2.89	21.85
Barren & uncultivable	1.02	0.58	-42.93
Permanent pasture & grazing	0.57	0.67	18.87
Land under misc. tree crops & groves	0.04	0.03	-30.00
Cultivable wasteland	0.71	0.70	-1.69
Other fallow	0.00	0.12	--
Current fallow	0.50	0.89	77.23
Net sown area	12.30	13.11	6.63

land, permanent pasture & grazing land and cultivable wasteland increased at an annual rate of 39848 ha, 38369 ha, 9979 ha, 8126 ha and 3927 ha, respectively during the period 2000-01 to 2019-20 (Table 1). Bardhan and Tewari (2010) found similar results in their study on state-wise land use dynamics in India. They found that the fallow land and net sown area increased at the aggregate level during the study period. In the present study, the area under the non-agriculture category also increased at the annual rate of 38352 ha. This indicated that the land area under forest and miscellaneous tree crops and groves shifted towards agricultural land or land for non-agriculture activities or both over the study period. The increase in area under agriculture and non-agriculture land may be at the cost of the ecological sector which may cause serious ecological consequences like extreme weather conditions. The current fallow land in south Gujarat increased annually by 38369 ha, implying that measures are needed to bring this area under cultivation to increase agricultural production.

Inter-sectoral land use shift

The inter-sectoral land use shift in South Gujarat during the period 2000-01 to 2019-20 is presented in Table 3. It was observed that the area under the ecological sector substantially declined at the annual rate of 169813 ha in south Gujarat, in which the contribution of the area under the desirable ecological sector was 80% and the area under the undesirable ecological sector was 20%. At an aggregate level the land area under the desirable ecological sector and undesirable ecological sector declined annually by 135915 ha and 33898 ha, respectively over the study period indicating the unfavourable shift in land use in the desirable ecological sector and favourable shift in land use in the undesirable ecological sector.

Further, Table 3 showed that the land area under the agricultural sector annually increased by 92106 ha which indicated that the increase in area under the agriculture sector in South Gujarat was at the cost of the desirable ecological sector. The annual rate of change for the land

Table 2. *Annual rate of change in land use classes in South Gujarat*

Land use sector	Land use categories	Annual rate of change (‘00 ha)
Ecological (E)	Forest (ΔF_r)	-1430.55
	Barren & uncultivable (ΔU)	-338.98
	Permanent pasture & grazing (ΔP)	81.26
	Land under misc crop (ΔM)	-9.86
Agriculture (A)	Net sown (ΔC)	398.48
	Current fallow (ΔF_c)	383.69
	Other fallow (ΔF_o)	99.79
	Cultivable wasteland (ΔW)	39.27
Non-agriculture (N)	Area under non-agriculture (ΔN)	383.52

Table 3. *Budgeting inter-sectoral land use shift in South Gujarat*

Land use sector	Annual rate of change (ha)
Ecological (ΔE)	-169813
Desirable ecological (ΔE_1)	-135915
Undesirable ecological (ΔE_2)	-33898
Agricultural (ΔA)	92106
Non agricultural (ΔN)	38352
Net sectoral change	-39355

Note: Net sectoral change = $\Delta N + \Delta A + \Delta E_1 + \Delta E_2$

area under the non-agricultural sector was worked out to 38352 ha, which showed an increase in non-agricultural land in South Gujarat during the study period. This rise in the land area under the non-agricultural sector may have occurred due to a shift in the area from the desirable ecological sector or undesirable ecological sector or both. The results are in conformity with the findings of Amale and Shiyani (2019) who found that the shift in landuse has been occurring from the desirable ecology towards agricultural and non-agricultural sectors from 1991-92 to 2014-15. Pushpa and Akashraj (2014) found that about 25 districts of Karnataka reported a shift in land towards non-agricultural use from other sectors. Samaya *et al.* (2011) found that there was a shift in the area from a desirable ecological sector towards a non-agricultural purpose in Karnataka. Meena *et al.* (2022) found that the land under non-agricultural purposes has increased. Several factors could be responsible for this trend, including increased population, urbanization and industrialization

Spatial distribution of land use categories

The location coefficient was worked out to study the spatial distribution of different land use categories in South Gujarat for the period from 2000-01 to 2019-20. The location coefficient for the area under forest, non-agricultural uses and net sown area was higher during the study period which indicated that there was a higher concentration of these categories of land in South Gujarat (Table 4). It was interesting to note that the location coefficient for forest was 2.49 during the year 2000-01 which gradually declined and reached up to 1.44 during the year 2019-20. This implied that the concentration of forest area in South Gujarat declined during the study period. The decline in the concentration of forest area may be due to the diversion of forest area towards other land use classes. The location coefficient for current fallow land in South Gujarat was 0.45 during 2000-01, which increased up to 1.26 during 2019-20 indicating a sharp increase in the area under fallow land during the study period. The increase in current fallow land may probably be due to erratic rainfall and scarcity of labour force in agriculture. Diversion of the labour force from agriculture to other better employment opportunities in urban areas may cause a serious shortage of labour in the agriculture sector. Similar results were found by Nasim *et al.* (2018) in their investigation to find factors responsible for variations in current fallow land in Bihar. He reported that rainfall and area under current fallow land have a negative relationship. Higher wage rates and employment opportunities in urban areas reduce the labour for agriculture. Kumar *et al.* (2017) found higher variability in the rainfall in the south Gujarat region during the period 1991-2015. Such variationin rainfall causes an increase in current fallow land. Common lands include culturable wasteland, permanent pastures and grazing land, and land under miscellaneous trees and groves. Less concentration of common land was found in the south Gujarat region during the study period. Hence, there is limited scope to use this land for agricultural purposes. The location coefficient of the net sown area was higher and remained more or less the same throughout the study period implying that the concentration of net sown area was higher and stable in the south Gujarat region.

The results of the present investigation revealed that the area under barren and uncultivable land, forest and land under miscellaneous tree crops and groves declined over the study period. It was found that the shift in land

Table 4: *Spatial distribution of land use categories in South Gujarat*

Land use classes	Location coefficient				
	2000-01	2005-06	2010-11	2015-16	2019-20
Forest	2.49	2.43	1.87	1.94	1.44
Area under non-agriculture	1.69	1.68	1.81	1.81	1.62
Barren & uncultivable	0.32	0.36	0.39	0.34	0.22
Common land	0.37	0.39	0.42	0.46	0.40
Current fallow	0.45	0.53	0.70	1.02	1.26
Net sown area	1.05	1.03	1.09	1.01	1.04

took place from forest, barren and uncultivable land and land under miscellaneous tree crops and groves to the other categories of land. The area under agriculture and non-agricultural land increased in South Gujarat. This increase in area may be due to the shifting of land area under forest and land under miscellaneous tree crops and groves towards agricultural land or land for non-agriculture activities or both over the study period. Such type of shifting of land may cause serious ecological consequences. The unfavourable shift in land use in the desirable ecological sector and the favourable shift in land use in the undesirable ecological sector were observed in South Gujarat. The land area under the agricultural sector annually increased by 92106 ha which was at the cost of a desirable ecological sector. The higher location coefficient for area under forest, area under non-agricultural uses and net sown area during the study period indicated that there was a higher concentration of these categories of land in South Gujarat. The location coefficient of current fallow land indicated a sharp increase in the area under fallow land during the study period which implied that suitable measures are needed to bring this area under cultivation to increase the agricultural production.

CONFLICTS OF INTEREST

There is no conflict of interest among all the authors.

REFERENCES

Amale, A.J. and Shiyani, R.L. (2019). Ecological implications of land use dynamics in Gujarat. *Agricultural Situation in India* **LXXV**(11): 37- 43.

Bardhan, D. and Tewari, S.K. (2010). An investigation into land use dynamics in India and land under-utilisation. *Indian Journal of Agricultural Economics* **65**(4): 659-676.

Kumar, N., Panchal, C.C., Chandrawanshi, S.K. and Thanki, J.D. (2017). Analysis of rainfall by using Mann-Kendall trend, Sen's slope and variability at five districts of south Gujarat, India. *Mausam* **68** (2): 205-222.

Mari Bhat, P.N. (2022). *Demographic Scenario, 2025*, Niti Ayog, Govt. of India, New Delhi, India. www.niti.gov.in/planningcommission/docs/reports/sereport/ser/vision2025/demogra.pdf.

Meena, G.L., Bairwa, K.C., Pawariya, V and Meena, L.K. (2022). Ecological assessment of land use changes in Rajasthan: Beginning of twenty-first century. *Agro Economist - An International Journal* **l9**(3): 207-211.

MSME. (2015). *South Gujarat the Industrial Hub, Vision 2020.* https://ic.gujarat.gov.in/documents/news/External-profile-South-Gujarat-Final7092017.pdf.

Nasim A., Sinha, D.K. and Singh K.M. (2018). Changes in land use pattern and factors responsible for variations in current fallow land in Bihar, India. *Indian Journal of Agricultural Research* **52**(3): 236-242.

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.

Pandey, V.K. and Tewari, S.K. (1987). Some ecological implications of land use dynamics in Uttar Pradesh. *Indian Journal of Agricultural Economics* **42**(3): 388-394.

Pushpa, C.O. and Akashraj, D.P. (2014). An investigation into land use dynamics in Karnataka - An ecological perspective. *Merit Research Journal of Agricultural Science and Soil Sciences* **2**(3): 047-052.

Raju, V.T. and Rao, D.V.S. (2009). *Economics of Farm Production and Management,* Oxford and IBH Pub. Co. Pvt. Ltd, New Delhi, India.

Ramasamy,C., Balasubramanian, R. and Sivakumar, S.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): 629-643.

Samaya, G., Kulkarni, G.N. and Vijayachandra Reddy S. (2011). Land use dynamics in Karnataka: Post economic liberalization. *Research Journal of Agricultural Sciences* **2**(4): 921-923.

Sharma, U.K. and Pandey, V.K. (1992). Dynamics of land use in different states of India. *Indian Journal of Agricultural Economics* **5**(1): 22-33.