Indian Journal of Agricultural Sciences **93** (3): 308–313, March 2023/Article
https://doi.org/10.56093/ijas.v93i3.102878

Agricultural sustainability in Karnataka: Application of Sustainable Livelihood Security Index

DEVENDRA BEERALADINNI[1]* and B L PATIL[2]

University of Agricultural Sciences, Raichur, Karnataka 584 104, India

Received: 27 July 2020; Accepted: 20 February 2023

ABSTRACT

The present study was carried out in Karnataka state to assess the relative agricultural sustainability status of Karnataka during the year 2021–22 using Sustainable Livelihood Security Index (SLSI). Three indicators, viz. Ecological Security, Economic Efficiency and Social Equity Index were used. The results of the study show that in Karnataka better conditions for sustainable agriculture exist in majority of the Southern districts. However, few Northern districts, viz. Belagavi, Raichur, Bagalkote and Ballari have better level of ecological security and some Southern districts Bengaluru (U), Bengaluru (R), Chikkaballapur, Kolar and Ramanagara have low level of ecological security. In economic efficiency and social equity indicator also, majority of the Northern districts lagged behind compared to southern districts while Belagavi and Kalburgi districts have shown better performance compared to rest of the districts in the state. Adoption of sustainable agricultural practices such as judicial use of fertilizers and plant protection chemicals, efficient water use techniques (drip and sprinkler irrigation), use of organic manures and diversification of farm activities would help in sustainable agricultural development. To achieve ecological sustainability, steps need to be taken to enhance forest cover through afforestation especially in the districts which have poor ecological security. Further, there is a need to enhance the crop yield, encourage dairy farming and improve work force participation through training and skill development in the districts with poor economic efficiency.

Keywords: Agricultural sustainability, Economic efficiency, Ecological security, Northern Karnataka

The apprehension about the agriculture sustainability began when the green revolution was successful in popularising the modern high technology in crop production around the world. Like all developmental activities, agricultural activities also affect the environment, land, water, forests, soil, genetic diversity of crop and livestock and other ecosystem services (Ramesh Chand 2010). The sustainable agriculture is aimed at meeting the society's present food and fibre needs without compromising needs of future generation. As sustainable agriculture is a set of agronomic practices that are economically viable, environmentally safe and socially acceptable, the new paradigm of agricultural development needs to be based on concurrent attention to the issues of ecological sustainability, economic viability and social equity (Swaminathan 1991). In recent past, the issue of agriculture sustainability in India has attracted the attention of policy makers due to the reason that the growth rates of output and productivity of several crops has declined in the states, where the green revolution was successful. The National Mission for Sustainable Agriculture was launched during 12th plan in India to make agriculture more productive, sustainable and remunerative by promoting sustainable farming systems, transforming agriculture into an ecologically sustainable production system and to ensure food security and economic stability. Sustainable Livelihood Security Index (SLSI) incorporates the basic and necessary conditions for sustainability of a system. These conditions are ecological security, economic efficiency and social equity. Each of three conditions can be represented by different variables based on availability of the data, appropriateness and the level at which the SLSI is constructed. The SLSI is simple to construct and conceptually sound but it also faces the problems encountered in the construction of composite index such as choosing the appropriate variable and assigning the appropriate weights to the different components (Singh and Hiremath 2010). Keeping these aspects in view, the present study aims at measuring the agricultural sustainability in Karnataka by computing SLSI for all the 30 districts of the state.

MATERIALS AND METHODS

The present study was carried out at University of Agricultural Sciences, Raichur, Karnataka during 2021–22.

[1]University of Agricultural Sciences, Raichur, Karnataka; [2]University of Agricultural Sciences, Dharwad, Karnataka. *Corresponding author email: beeraladinnidevendra1975@gmail.com

The study is based on secondary data compiled from official websites of various state and central government departments. The district wise data were collected from annual vital statistics report of Government of Karnataka (GoK) (www.ejanma.karnataka.gov.in), Department of Economics and Statistics, Bengaluru (www.kgis.ksrsac.in), and Central Ground Water Board (CGWB), Faridabad (www.cgwb.gov.in). The Sustainable Livelihood Security Index was constructed by selecting 20 variables and the data on these variables were grouped under three components, viz. ecological security, economic efficiency and social equity indicators. The variables grouped under each component have a positive or negative influence on the agricultural sustainability and accordingly these variables have been assigned a positive or negative sign.

Ecological security indicators (ESI): Ecological security index was assessed by using seven variables, viz. population growth in percentage (-), population density per square kilometre (-), proportion of geographical area under forest (+), cropping intensity (+), percentage of livestock population to state total (+), net irrigated area in lakh hectares (+), net annual ground water availability in hectare meters (+).

Economic efficiency indicators (EEI): The economic efficiency indicator was measured by considering five variables such as total food grain yield in kilogram per hectare (+), total milk production in million tonnes (+), net sown area in lakh hectare (+), fertilizer consumption in kilogram per hectare (+) and labour force participation rate (+).

Social equity indicators (SEI): The social equity indicator was calculated by selecting the following eight variables namely rural road connectivity in kilometres (+), percentage of household electrified (+), number of commercial bank branches (+), number of primary health centres (+), percentage of population below poverty line (-), literacy rate (+), female literacy rate (+) and infant mortality rate (-).

Analytical tool: The Sustainable Livelihood Security Index (SLSI) has been computed from these three indices as detailed below.

Where Z_{ijk}, the index value measuring the performance of i^{th} variable for k^{th} district in j^{th} component and X_{ijk}, the value of i^{th} variable representing j^{th} component for k^{th} district. If i^{th} variable has a positive influence on the agriculture sustainability, the index value (Z_{ijk}) of an individual variable can be estimated by taking the ratio of deviation of all X_{ijk} from its minimum value to the difference between the maximum and minimum value of X_{ijk} which indicates the relative performance of the k^{th} district. This can be expressed as:

$$Z_{ijk} = \frac{X_{ijk} - MinkX_{ijk}}{MaxkX_{ijk} - MinkX_{ijk}} \quad (1)$$

If the i^{th} variable has a negative influence on the agriculture sustainability, then the expression can be written as

$$Z_{ijk} = \frac{MaxkX_{ijk} - X_{ijk}}{MaxkX_{ijk} - MinkX_{ijk}} \quad (2)$$

Where i, variables (1,2,3,.....i), i is not fixed in all components; j, components (1,2,3); k, districts (1,2,3.....30); X_{ijk}, value of the i^{th} variable in j^{th} component for k^{th} district; $MaxkX_{ijk}$, maximum value of i^{th} variable in j^{th} component for k^{th} district; $MinkX_{ijk}$, minimum value of i^{th} variable in j^{th} component for k^{th} district; and Z_{ijk}, index value of i^{th} variable in the component.

Z_{ijk} values lies between 0 and 1. In case i^{th} variable has positive influence on agriculture sustainability and Z_{ijk} is near to 1, that indicates better performance of the district and if Z_{ijk} value is near to 0, it indicates poor performance of the district. Similarly, in case i^{th} variable has negative influence and Z_{ijk} is near to 0 that indicates poor performance of the district and if Z_{ijk} is near to 1, that indicates better performance.

After calculating the index value for all the variables the index value of each of the three components were calculated by taking the average of the indices of the respective variables. Hence, the following expressions for three index values Z_{ESI}, Z_{EEI} and Z_{SEI} were made

$$Z_{ESI} = \sum_{i=1}^{n} Z_{ijk}/n, \text{ where } n = 7$$

$$Z_{EEI} = \sum_{i=1}^{n} Z_{ijk}/n, \text{ where } n = 5$$

$$Z_{SEI} = \sum_{i=1}^{n} Z_{ijk}/n, \text{ where } n = 8$$

Then, the SLSI value for each district was estimated by taking the arithmetic mean of its component indices. This can be expressed as:

$$SLSI_k = \frac{Z_{ESI} + Z_{EEI} + Z_{SEI}}{3} \quad (3)$$

Where $SLSI_k$, Agricultural sustainability index of kth district; Z_{ESI}, Ecological security index; Z_{EEI}, Economic efficiency index; and Z_{SEI}, Social equity index. After testing the normality of SLSI and its component indices values, the districts were grouped under three conditions of agriculture sustainability (Better, Moderate and Poor). Let $\overline{X}$, mean of SLSI; and σ, Standard deviation of SLSI.

Less than ($\overline{X}$- 0.425σ) = Poor

($\overline{X}$- 0.425σ) to (SLSI + 0.425σ) = Moderate

Above ($\overline{X}$ + 0.425σ) = Better

RESULTS AND DISCUSSION

Sustainable livelihood security index and component indicator for Karnataka: The Sustainable Livelihood Security Index (SLSI) for the year 2011 with its three component indices for different districts of Karnataka are presented in Table 1. The results of the study revealed that the values of agriculture sustainability status ranged from 0.736 for Belagavi to 0.095 for Bengaluru (U) in ecological

sustainability index, 0.570 for Chitradurga to 0.225 for Kalburgi in economic efficiency index and 0.789 for Bengaluru (U) to 0.168 for Yadgiri in social equity index. When the SLSI is considered, the districts Hassan, Belagavi, Tumakuru, Mandya, Dakshina Kannada, Shivamogga, Chikkamagaluru, Udupi, Uttara Kannada and Mysuru showed high level of agricultural sustainability index with 1^{st}–9^{th} ranks. Whereas, Chamarajanagar, Bengaluru Urban (U), Ballari, Vijayapura, Koppal, Gadag, Dharwad, Kalburgi, Bidar, Raichur and Yadgiri with ranks from 20^{th}–30^{th} showed a low level of livelihood security index. The districts, viz. Davanagere, Kodagu, Ramanagara, Haveri, Chitradurga, Chikkaballapura, Bengaluru Rural, Bagalkote and Kolara showed a moderate level of livelihood security index with ranks 11^{th}–19^{th}. Similar results were obtained by Devi L G (2018) who examined three dimensions of sustainability, i.e. economic, social and ecological sustainability in Manipur state.

The Sustainable Livelihood Security Index (SLSI) and its three component indices for different districts of Karnataka for the year 2019 are presented in Table 2. It was found that the districts Belagavi, Shivamogga, Raichur, Mysuru, Uttara Kannada, Mandya, Chikkamagaluru, Tumakuru, Bagalkote, Kodagu and Ballari districts performed better whereas, Bengaluru Urban (U), Bengaluru Rural (R), Kolar, Ramanagara, Chikkaballapur and Bidar performed poor in ecological security indicator as majority of these districts have high population growth, high population density, less area under forest, low cropping intensity, less livestock population, less irrigated area and low level of ground water availability. Among the districts which performed poor in economic efficiency, majority have less milk production, less net sown area and low labour force participation rate. About 11 districts have moderate performance under economic efficiency. With regard to social equity aspect, 10 districts have performed better as these districts have good rural road network, higher household electrified, more number of bank branches, more number of primary health centres, low population below poverty line and high literacy levels. On the other hand, 10 districts have performed poor in social equity due to high population below poverty line, low literacy rate, less commercial banks and less number of households electrified.

The SLSI indicated that the districts, viz. Hassan, Belagavi, Udupi, Tumakuru, Shivamogga, Uttara Kannada, Dakshina Kannada, Mandya, Mysuru and Davanagere have the best conditions for sustainable development of agriculture. The districts having poor conditions for sustainable agriculture development include Yadgiri, Bidar, Dharwad, Bengaluru (U), Koppal, Ramanagara, Raichur, Bengaluru (R), Chitradurga and Gadag. The results obtained by Ashish Prakash *et al.* (2019) revealed that only one district in Uttarakhand was grouped under low status of SLSI, nine districts were grouped under moderate status, three districts were grouped under high status and none of the districts were positioned in the very high status of agricultural sustainability.

Table 1 Indices of Sustainable Livelihood Security (SLS) and component indicators of districts of Karnataka

District	ESI	EEI	SEI	SLSI	Rank
Hassan	0.631	0.546	0.623	0.600	1
Belagavi	0.736	0.435	0.579	0.583	2
Tumakuru	0.541	0.537	0.670	0.583	3
Mandya	0.623	0.525	0.576	0.575	4
Dakshina Kannada	0.495	0.509	0.676	0.560	5
Shivamogga	0.653	0.450	0.553	0.552	6
Chikkamagaluru	0.532	0.552	0.566	0.550	7
Udupi	0.531	0.461	0.645	0.546	8
Uttara Kannada	0.524	0.403	0.642	0.523	9
Mysuru	0.639	0.388	0.514	0.514	10
Davanagere	0.549	0.465	0.490	0.501	11
Kodagu	0.457	0.547	0.460	0.488	12
Ramanagara	0.422	0.556	0.473	0.484	13
Haveri	0.465	0.497	0.484	0.482	14
Chitradurga	0.433	0.570	0.440	0.481	15
Chikkaballapur	0.398	0.564	0.421	0.461	16
Bengaluru (R)	0.349	0.532	0.496	0.459	17
Bagalkote	0.523	0.458	0.364	0.448	18
Kolar	0.383	0.431	0.513	0.442	19
Chamarajanagar	0.494	0.491	0.389	0.434	20
Bengaluru (U)	0.095	0.400	0.789	0.428	21
Ballari	0.484	0.371	0.396	0.417	22
Vijayapura	0.427	0.410	0.400	0.413	23
Koppal	0.472	0.405	0.305	0.394	24
Gadag	0.414	0.355	0.401	0.390	25
Dharwad	0.483	0.259	0.364	0.369	26
Kalburgi	0.409	0.225	0.421	0.352	27
Bidar	0.387	0.316	0.345	0.349	28
Raichur	0.526	0.304	0.211	0.347	29
Yadgiri	0.432	0.311	0.168	0.304	30

ESI, Ecological security indicators; EEI, Economic efficiency indicators; SEI, Social equity indicators; and SLSI, Sustainable Livelihood Security Index (SLSI).

Spatio-temporal variation of agricultural sustainability in Karnataka: The spatio temporal variation in agricultural sustainability in Karnataka state was assessed by estimating the SLSI and its components for two periods 2011–12 and 2018–19 and the results are presented in Table 2. In ecological sustainability among the northern districts, Belagavi was the only district under better performing category in 2011–12, whereas in 2018–19 the number of better performing districts increased to five (Belagavi, Raichur, Uttara Kannada, Bagalkote and Ballari). Similarly in economic efficiency indicator, Haveri was the only district in better performing category in 2011–12, whereas in 2018–19 the number of better performing districts increased to three (Haveri, Belagavi and Kalburgi). Among

Table 2 SLSI and component indicators for Northern and Southern districts of Karnataka state in 2019

District	ESI	EEI	SEI	SLSI	Rank
Northern districts					
Belagavi	0.678	0.584	0.632	0.631	2
Bagalkote	0.523	0.401	0.428	0.451	17
Vijayapura	0.429	0.476	0.464	0.456	16
Kalburgi	0.458	0.490	0.391	0.446	19
Bidar	0.390	0.283	0.404	0.359	29
Raichur	0.598	0.344	0.316	0.419	24
Koppal	0.447	0.342	0.352	0.380	26
Gadag	0.411	0.419	0.481	0.437	21
Dharwad	0.417	0.179	0.484	0.360	28
Uttara Kannada	0.553	0.384	0.782	0.573	6
Haveri	0.423	0.563	0.443	0.476	13
Ballari	0.505	0.480	0.510	0.498	11
Yadgir	0.463	0.390	0.173	0.342	30
Southern districts					
Chitradurga	0.434	0.380	0.472	0.429	22
Davanagere	0.435	0.583	0.531	0.516	10
Shivamogga	0.606	0.482	0.636	0.575	5
Udupi	0.465	0.561	0.718	0.581	3
Chikkamagaluru	0.525	0.329	0.621	0.492	12
Tumkuru	0.524	0.582	0.629	0.578	4
Kolar	0.309	0.484	0.560	0.451	18
Bengaluru (U)	0.059	0.383	0.695	0.379	27
Bengaluru (R)	0.258	0.454	0.565	0.426	23
Mandya	0.543	0.432	0.607	0.527	8
Hassan	0.500	0.714	0.790	0.668	1
Dakshina Kannada	0.443	0.394	0.770	0.536	7
Kodagu	0.508	0.415	0.504	0.476	14
Mysuru	0.560	0.420	0.577	0.519	9
Chamarajanagar	0.474	0.438	0.420	0.444	20
Chikkaballapur	0.366	0.547	0.483	0.465	15
Ramanagara	0.347	0.394	0.465	0.402	25

ESI, Ecological security indicators; EEI, Economic efficiency indicators; SEI, Social equity indicators; and SLSI, Sustainable Livelihood Security Index (SLSI).

the southern districts in economic efficiency indicator 10 districts were in better performing category in 2011–12 whereas in 2018–19 the number of better performing districts decreased to five which implied that the condition for agricultural sustainability in southern Karnataka got a setback (Table 3). Similar findings have been reported by Deshmukh and Digvijay (2020).

The values of SLSI and its components for the southern and northern districts revealed that among the northern districts only one district (Belagavi) performed better in ecological security. However, majority of the districts performed moderately and only five districts performed poor because of low geographical area under forest, high population density, low cropping intensity and livestock density, less irrigated area and high population growth. While, among the southern districts six districts performed better, six districts have performed poor and majority of the districts have moderate performance. In economic efficiency also, only one northern district (Haveri) performed better as it had second highest food grain yield (2839 kg/ha), more milk production and high labour force participation (45.70%) compared to other districts in the state. Only five districts performed moderately and majority of the districts have shown poor performance due to low food grain yield, low milk production, less net sown area and low labour participation rate. When southern districts were taken into consideration majority exhibited better performance, five showed moderate performance and only one district (Mysuru) appeared in the poor performing category.

With respect to social equity aspect majority of the northern districts except Belagavi and Uttara Kannada (as these districts had low population density, low infant mortality rate, high literacy rate and more length of rural roads) appeared in poor performing category while majority of the southern districts appeared in better and moderate performing category except Chamarajnagara which has shown poor performance because of low literacy rate, less length of rural roads, less percentage of households electrified and less number of commercial banks. Similar findings were reported by Bharti and Sen (1997) who conducted a study on the overall performance of the districts in terms of their relative Sustainable Livelihood Security Index (SLSI) and results of the study showed that most of the districts of south Bihar had better agricultural sustainability in comparison to the districts of north Bihar.

It is evident from the results that only two districts Belagavi in north Karnataka and Tumakur in south Karnataka have performed better in both SLSI and individual components while, remaining districts have performed better in one or two components. Thus, the condition for agricultural sustainability existed during 2011 in the districts of northern Karnataka was improved in 2019. This remarkable progress in the condition of agricultural sustainability in northern Karnataka was attributed to special attention and plans of state and central government to reduce the regional imbalance. Particularly, in North Eastern Karnataka region allocation of funds under Special Development Plan helped the backward taluks to accelerate the development process. Further, the growth in agricultural sector of the region also triggered to a certain extent through the creation of Backward Region Grant Fund.

Thus, better conditions for sustainable agriculture exist in majority of the southern Karnataka districts compared to the Northern districts. However, the index values of individual components of SLSI revealed that in northern Karnataka the districts such as Belagavi, Raichur, Bagalkote, Ballari and Uttara Kannada have better level of ecological security as these districts have larger forest area (except Raichur), high cropping intensity (except Uttara Kannada),

Table 3 Classification of districts in Karnataka based on the index values

Category	Districts under different component indicators					
	ESI		EEI		SEI	
	2011	2019	2011	2019	2011	2019
Better	Belagavi	Belagavi	Chitradurga	Hassan	Bengaluru (U)	Hassan
	Shivamogga	Shivamogga	Chikkaballapur	Belagavi	Dakshina Kannada	Uttarakannada
	Mysuru	Raichur	Ramanagar	Davanagere	Tumakuru	Dakshinakannada
	Hassan	Mysuru	Chikkamagalur	Tumakuru	Udupi	Udupi
	Mandya	Uttara Kannada	Kodagu	Haveri	Uttara Kannada	Bengaluru (U)
	Davanagere	Mandya	Hassan	Udupi	Hassan	Shivamogga
	Tumakuru	Chikkamagaluru	Tumakuru	Chikkaballapur	Belagavi	Belagavi
		Tumakuru	Bengaluru (R)	Kalburgi	Mandya	Tumakuru
		Bagalkote	Mandya		Chikkamagaluru	Chikkamagalur
		Kodagu	Dakshina Kannada		Shivamogga	Mandya
		Ballari	Haveri			
Moderate	Chikkamagaluru	Hassan	Davanagere	Kolar	Mysuru	Mysuru
	Udupi	Chamarajanagar	Udupi	Shivamogga	Kolar	Bengaluru (R)
	Raichur	Udupi	Bagalkote	Ballari	Bengaluru (R)	Kolar
	Uttara Kannada	Yadgiri	Shivamogga	Vijayapura	Davanagere	Davanagere
	Bagalkote	Kalburgi	Belagavi	Bengaluru (R)	Haveri	Ballari
	Dakshina Kannada	Koppal	Kolar	Chamarajanagar	Ramanagar	Kodagu
	Chamarajanagar	Dakshinakannada	Chamarajanagar	Mandya	Kodagu	Dharwad
	Ballari	Davanagere	Vijayapura	Mysuru	Chitradurga	Chikkaballapur
	Dharwad	Chitradurga	Koppal	Gadag	Chikkaballapur	Gadag
	Koppal	Vijayapura	Uttara Kannada	Kodagu	Kalburgi	Chitradurga
	Haveri	Haveri	Bengaluru (U)	Bagalkote		
	Kodagu	Dharwad				
		Gadag				
Poor	Chitradurga	Bengaluru (U)	Mysuru	Ramanagara	Gadag	Ramanagara
	Yadgiri	Bengaluru (R)	Ballari	Dakshinakannada	Vijayapura	Vijayapura
	Vijayapura	Kolar	Gadag	Yadgiri	Ballari	Haveri
	Ramanagar	Ramanagara	Bidar	Uttarakannada	Chamarajanagar	Bagalkote
	Gadag	Chikkaballapur	Yadgiri	Bengaluru (U)	Bagalkote	Chamarajanagar
	Kalburgi	Bidar	Raichur	Chitradurga	Dharwad	Bidar
	Chikkaballapur		Dharwad	Raichur	Bidar	Kalburgi
	Bidar		Kalburgi	Koppal	Koppal	Koppal
	Kolar			Chikkamagaluru	Raichur	Raichur
	Bengaluru (R)			Bidar	Yadgiri	Yadgiri
	Bengaluru (U)			Dharwad		

ESI, Ecological security indicators; EEI, Economic efficiency indicators; and SEI, Social equity indicators.

high livestock population (except Uttara Kannada), larger irrigated area (except Uttara Kannada) and high annual ground water availability (except Bagalkote). In economic efficiency indicator also majority of the northern districts lagged behind compared to southern districts. The districts Dharwad, Bidar, Koppal, Raichur and Yadgir have shown poor performance under economic efficiency while Belagavi and Kalburgi districts have shown better performance. Similarly, in social equity aspect also, majority of the northern districts fell under poor performing category with low value of social equity index. The northern districts which have lagged behind with respect to social equity include Yadgir, Raichur, Koppal, Kalburgi, Bidar, Bagalkote, Haveri and Vijayapura compared to other districts in the state. Similar findings have been reported by Suresh Kumar *et al.* (2014). Southern part of the Karnataka state comprising 17 districts was categorised as sustainable and highly sustainable whereas 13 districts of northern Karnataka were categorised under less sustainable and very less sustainable as these districts exposed to the perils of uncertain rainfall, high soil erosion, high social inequality and poor resource use efficiency.

Based on the findings of the study following conclusion and policy implications are drawn. The districts in southern part of the Karnataka (Kolar, Bengaluru rural and urban, Chikkaballapura and Ramanagara) require ardent policy attention to strengthen the ecological dimensions by increasing area under forest, enhancing cropping intensity,

encouraging livestock farming and bringing more area under irrigation. The districts Yadgiri, Bidar, Dharwad, Bengaluru (U), Koppal, Ramanagara, Raichur, Bengaluru (R), Chitradurga and Gadag had shown poor SLSI. Hence, there is a need to promote the sustainable agricultural practices such as judicial use of fertilizers and plant protection chemicals, adaption of efficient water use techniques such as drip and sprinkler irrigation systems, use of organic manures and diversification of farm activities.

The districts Ramanagara, Dakshina Kannada, Yadgiri, Uttara Kannada, Bengaluru (U), Chitradurga, Raichur, Koppal, Chikkamagaluru, Bidar and Dharwadhave performed poor in economic efficiency and ecological security indicators.Therefore, to achieve this steps needs to be taken to enhance the crop yield, encourage dairy farming and improve work force participation through training and skill development. The study also highlights that only few variables were used to analyse the agricultural sustainability through SLSI in past studies. Hence, other important indicators of agricultural sustainability such as agricultural GDP, yield of horticultural crops, area under sericulture, yield of commercial crops, length of river, agriculture marketing institutes, crop insurance, land use pattern, migration and rainfall can also be considered while constructing SLSI that may give a clear status of agricultural sustainability at district or state level.

REFERENCES

Ashish Prakash, Singh H N and Vijay Kumar Pal. 2019. Sustainable livelihood security in Uttarakhand state: A micro economic evidence of district level analysis. *Pantnagar Journal of Research* **17**(2): 114–19.

Bharti D K and Sen C. 1997. Agricultural sustainability in Bihar: An evaluation of relative status of different districts. *Journal of Agriculture Development and Policy* **9**(02): 1–13.

Deshmukh M S and Digvijay R P. 2020. Economic analysis of agricultural sustainability in Satara district of Maharashtra. *Agriculture Situation in India* **77**(3): 10–20.

Devi L G. 2018. Sustainability of rice farming in hilly region of Manipur: A district level analysis. *Journal of Pharmacognosy and Photochemistry* **7**(1S): 1510–13.

Ramesh Chand. 2010. SAARC Agricultural Vision 2020. *Agricultural Economics Research Review* **23**: 197–08.

Singh P K and Hiremath B N. 2010. Sustainable Livelihood Security Index in a developing country: A tool for development planning. *Ecological Indicators* **10**(2): 442–51.

Suresh Kumar, Raizada A and Biswas H. 2014. Prioritising development planning in the Indian semi-arid Deccan using sustainable livelihood security index approach. *The International Journal of Sustainable Development and World Ecology* **21**(4): 332–45.

Swaminathan M S. 1991. Sustainable agricultural systems and food security. *Outlook on Agriculture* **20**(4): 243–49.