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Sustainable Livelihood Security Vis-à-Vis Agricultural Sustainability in India: A Case Study of Karnataka, India

Srinatha, T. N. [a++*], Pramod Kumar [a#], Arun, D. [a++], Debasmita Baruah [b++], Praveenkumar A. [c++], Pooja Rajendra Dhange [d++] and Anbukkani Perumal [a†]

[a] Division of Agricultural Economics, ICAR-Indian Agricultural Research Institute, New Delhi, India.
[b] Department of Agricultural Economics, Assam Agricultural University, Jorhat, Assam, India.
[c] Division of Agricultural Statistics, ICAR- Indian Agricultural Statistics Research Institute, New Delhi, India.
[d] Department of Horticulture, University of Agricultural Sciences, GKVK, Bengaluru, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Sustainable Development (SD) has gained prominence as a central focus for development planners, policymakers, and environmental advocates, both nationally and internationally. In India, agriculture grapples with numerous challenges that collectively contribute to sustainability issues, hindering its core goal of ensuring food security. Swaminathan [1] defines Sustainable Livelihood Security (SLS) as encompassing livelihood options that are ecologically sound, economically viable, and socially equitable. The intrinsic connections between SLS and broader welfare objectives such as poverty reduction and human development underscore its pivotal role in achieving sustainable

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[++] *Research Scholar;*
[#] *Principal Scientist;*
[†] *Senior Scientist*
**Corresponding author: Email: srinathtn.vk18@gmail.com;*

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development. This study employs the Sustainable Livelihood Security Index (SLSI) to assess the current status of sustainability in the agriculturally diverse state of Karnataka. Factors like population density, forest cover, cropping intensity, and livestock density are utilized to gauge ecological security. Economic efficiency is measured through per capita income, milk yield, and net sown area, while social equity is assessed by indicators like female literacy, maternal mortality rate, and the percentage of the population below the poverty line (BPL). Despite inherent variations and limitations, these selected variables offer substantial insight into the overall ecological, economic, and equity dimensions of the state. The results reveal a wide range of values for sustainability status (WSLSI), spanning from 0.17 to 0.62, with corresponding ranges of 0.07 to 0.64 for economic efficiency (EEI), 0.17 to 0.77 for ecological security (ESI), and 0.12 to 0.95 for social equity (SEI). This indicates significant disparities in the livelihood security of Karnataka across its ecological, economic, and social dimensions. Notably, the districts of Dakshina Kannada, Udupi, and Chikkamagaluru emerge as top performers in both simple SLSI and weighted SLSI, excelling in all three component indices. Conversely, districts such as Raichur, Yadagiri, and Koppal exhibit lower performance across all indices, highlighting the urgent need for targeted interventions in health, education, and agricultural investment. Strategies such as technological advancements, improved infrastructure, establishment of food processing industries, and enhanced financial and marketing support are recommended to address these disparities and bolster sustainable livelihood security in underperforming districts.

Keywords: Sustainability; economic efficiency; ecological security; social equity.

1. INTRODUCTION

India, being primarily agrarian, relies on agriculture for the livelihood of nearly half of its population. Despite significant technological advancements, the sector grapples with numerous challenges, hindering sustainability and exacerbating the struggle to feed the country's expanding populace. Shifting consumption patterns, population growth, and rising incomes drive up demand for agricultural products, while issues like water scarcity, soil degradation, and climate change threaten production. Additionally, agricultural instability, dwindling profits, and declining productivity prompt many farmers to leave the sector, further impeding its development. Bottlenecks in production and marketing, including limited access to modern technology, outdated farming methods, insufficient credit and investment, and inadequate marketing infrastructure, contribute to stagnation [2].

Sustainable agriculture entails managing resources to meet evolving human needs while preserving or enhancing environmental quality and conserving natural resources. It aims not only for efficient production but also for environmental, economic, and social well-being [3,4]. Key goals include ecological balance, economic efficiency, and social equity, as commercial agriculture often leads to environmental degradation. Sustainable agricultural development seeks to preserve resources for future generations while meeting present and future food demands. Social equity is crucial for effectively managing resources and achieving ecological and economic sustainability [5,6]. As we witness the environmental degradation in the name of commercial agriculture, development of sustainable agricultural systems is the need of the hour. Sustainable agricultural development focus on preserving natural resources for future generations and maintaining ecological balance in order to meet the food demands of both present generation and future generations in terms of both quantity and quality of food products [7,8]. To achieve ecological balance and economic efficiency, social equity plays a vital role in successful management of resources for efficient production system. With this background an attempt is made to understand the relative status of sustainable livelihood security in the well diversified state of Karnataka where agriculture is the major occupation with the following objectives

1. To assess the Ecological Security, Economic Efficiency and Social Equity in the state of Karnataka (India).
2. To evaluate the status Sustainable Livelihood Security in Karnataka (India).

To measure the sustainability in terms of ecological security, economic efficiency and social equity Sustainable Livelihood Security Index (SLSI) has been developed by Swaminathan [1] which has the potential of evaluating sustainable development (SD). The concept of Sustainable Livelihood Security (SLS), as defined by Swaminathan [1], is 'livelihood options which are ecologically secure, economically efficient and socially equitable'. The intimate conceptual, casual and operational linkages between SLS and other welfare goals like poverty alleviation, meeting basic needs for human development and quality of life [9] justify SLSI as a basic requirement of sustainable development of agriculture (SDA) [10,11].

Karnataka is one of the major agriculture dependent states of India and which has great diversity in terms of ecological, economic and social aspects. *Karnataka* is divided into 10 *agro-climatic zones*, including dry zones covering around 9.15 million hectares. Karnataka has long coastline, perennial rivers and varying agro-climatic zones. The climate endowment supports cultivation of cash crops like coffee, coconut, mango, spices, commercial flowers, aromatic plants, cotton, sugarcane, oilseeds, grapes, pomegranate, sapota, etc. apart from many cereals and pulses cultivation and helps 65 per cent of the population of Karnataka to engage in farming activities (NDDB, 2015). In the present study, Sustainable Livelihood Security Index (SLSI) tool has been used for assessing and evaluating the existing status of agricultural sustainability in selected states. Some measures have also been suggested to promote sustainable agriculture in India.

2. REVIEW OF LITERATURE

The Sustainable Livelihood Security Index (SLSI) is a composite indicator used to assess the status of livelihood security in India. It considers various dimensions such as income, employment, education, health, and social protection to provide a holistic view of livelihood sustainability [12]. Agricultural sustainability is critical for ensuring food security, rural livelihoods, and environmental conservation in India. Research has focused on various aspects such as soil health management, water resource utilization, crop diversification, and adoption of sustainable farming practices (Sharma et al., 2020). Sustainable livelihoods are closely linked to agricultural practices in India, particularly among rural communities. Studies highlight the importance of integrating livelihood security considerations into agricultural policies and programs [13]. Sustainable farming approaches such as organic agriculture, agroforestry, and conservation farming contribute to both livelihood enhancement and environmental sustainability.

3. METHODOLOGY

The analytical approach used to ascertain sustainable livelihood security is the SLSI which is a composite index of three indices, viz. Ecological Security Index (ESI), Economic Efficiency Index (EEI) and Social Equity Index (SEI) as it accounts for the conflicts and synergies among economic, social and ecological aspects of Sustainable development.

The SLSI is a relative approach and proposed based on the similar procedure of Human Development Index, developed by UNDP. Let X_{ijk} reflects the value of the i^{th} variable, j^{th} indices of k^{th} district and SLSI is the index for the i^{th} variable representing the j^{th} indices of the SLSI of k^{th} district Then Equation (1) is applicable to variables having positive implications for SLS which means the sustainability increases with the increase in the value of a particular variable and Equation (2) is applicable to variables having negative implications for SLS i.e. sustainability decreases with increase in the value of a particular variable and vice-versa. The numerators in Equation (1) measure the extent by which the kth district did better in the ith variable representing the jth component of its SLSI as compared to the region(s) showing the worst performance. The denominator is actually the range, i.e., the difference between the maximum and minimum values of a given variable across districts, which is a simple statistical measure of total variation evinced by that variable.

$$\mathrm{SLSI}_{ijk} = \frac{\mathrm{X}_{ijk} - \underset{k}{\min} \mathrm{X}_{ijk}}{\underset{k}{\max}\mathrm{X}_{ijk} - \underset{k}{\min}\mathrm{X}_{ijk}} \quad ...(1) \qquad SLSI_{ijk} = \frac{\underset{k}{max}\, X_{ijk} - X_{ijk}}{\underset{k}{max}\, X_{ijk} - \underset{k}{min}\, X_{ijk}} \quad ...(2)$$

where,

i = Variables (1, 2, 3, ………………., I), j = Components (1, 2, 3, J)
k = Districts (1, 2, 3,……………., K)

Having calculated the $SLSI_{ijk}$ for all variables, the indices for various components of SLSI were calculated as a simple means of the indices of their respective variables, i.e.:

$$SLSI_{jk} = \frac{\sum_{i=1}^{I} SLSI_{ijk}}{I} \quad (3)$$

where,

j = 1, 2, 3,……………….,J, and, k = 1, 2, 3,………………,K

Then, the composite indicator for each region was calculated as a weighted mean of the component indices obtained from Equation (3), i.e.

$$SLSI_{k} = \frac{\sum_{j=1}^{J} W_{jk}\, SLSI_{ijk}}{I} \quad (4)$$

The W_{jk} in Equation (4) denotes the weight assigned to the jth component of SLSI of kth region, and has the property that: W_{ik} +……………………+ W_{jk} = 1. If the weights are identical and sum up to unity, then SLSI is calculated as a simple mean. But, when the weights are different across all js and ks, then SLSI is calculated as a weighted mean. For distinction, the former has been denoted simply as 'SLSI' and the latter as 'WSLSI'.

The procedure of calculating weights is as follows: first, the inverse of the proportional contributions of ESI, EEI and SEI to SLSI is to be obtained. Then, the weights to be assigned to each component will be the ratio of its inverse contribution to the sum of all the three inverse proportions [9,12,13].

Due to lack of availability of data on all the variables and to maintain principle of parsimony, only 3-4 variables from each component have been selected to illustrate the three dimensions of SDA from Table 1 and explained in detailed below (Table 1).

3.1 Rationale Behind Choosing the Variables

3.1.1 Ecological security

Forests are crucial for maintaining ecological equilibrium and are integral to the state economy through the provision of non-timber forest products. Forest-related activities also play a key role in ensuring food security and supporting the livelihoods of forest-dependent communities[14,15,16].

Therefore, the forest cover variable was chosen to ensure ecological security. Cropping intensity serves as an indicator of agricultural development, representing the extent of land utilized for crop cultivation in a given period. With the expansion of irrigation infrastructure, more land has been cultivated, allowing farmers to grow multiple crops in the same area within a year. Assessing agricultural sustainability in terms of ecological security requires considering cropping intensity due to its significant impact.

3.1.2 Economic efficiency

Net sown area directly impacts food grain production, thus affecting farmers' economic efficiency. Therefore, it was chosen as a variable to assess agricultural sustainability. Per capita income serves as a reflection of overall living standards and economic prosperity, making it an apt indicator of economic efficiency. Additionally, milk yield was selected to represent economic efficiency, given the significant role of dairy farming as a major subsidiary occupation in Karnataka [14].

3.1.3 Social equity

Female literacy rate, maternal mortality rate, and the population below the poverty line are crucial indicators of social equity in agricultural sustainability. Female literacy signifies women's empowerment and their potential for economic participation, while maternal mortality rate reflects health awareness and facility accessibility [14]. The population below the poverty line provides insight into overall social equity within a region. Despite limitations, these selected variables effectively capture ecological, economic, and equity aspects of the the state's agricultural systems [15,16].

Table 1. List of variables selected and their functional relationship with sustainable livelihood security

Sl. No.	Components	Variables	Unit	Functional Relationship
1	Ecological security index	Population density (-)	/km^2	Negative
		Forest cover (+)	Percentage	Positive
		Cropping intensity (+)	Percentage	Positive
		Livestock density (-)	/km^2	Negative
2	Economic efficiency index	Net Sown Area (+)	kg/ha	Positive
		Milk Yield (+)	litres/day	Positive
		Per capita income (+)	Rs/ annum	Positive
3	Social equity index	Female literacy (+)	Percentage	Positive
		Infant Mortality (-)	Percentage	Negative
		BPL (-)	Percentage	Negative

4. RESULTS AND DISCUSSION

The variables considered for Economic Efficiency are Net Sown Area, Milk Yield and Per Capita Income. The net sown area was found highest in Hassan followed by Ramanagar, Belagavi and Haveri with net sow area of 81.55, 81.07, 78.80 and 77.86 per cent, respectively. Net sown area is lowest in Uttarakannada followed by Yadgir and Tumakuru.

Table 2. District wise ecological security index of Karnataka (India)

Sl. No.	Districts	Population density Index	Forest cover Index	Copping Intensity Index	Livestock density Index	ESI	Rank
01.	Bagalkot	0.96	0.13	0.45	0.00	0.39	25
02.	Bengaluru Rural	0.94	0.04	0.00	0.34	0.33	28
03.	Bengaluru Urban	0.00	0.01	0.16	0.53	0.17	30
04.	Belagavi	0.95	0.16	0.57	0.19	0.47	16
05.	Bellary	0.96	0.13	0.67	0.31	0.52	11
06.	Bidar	0.96	0.04	0.36	0.61	0.49	14
07.	Vijayapura	0.98	0.00	0.17	0.65	0.45	19
08.	Chamarajnagara	0.99	0.60	0.54	0.72	0.71	2
09.	Chickkaballapura	0.96	0.13	0.11	0.14	0.34	27
10.	Chikkamagaluru	0.99	0.34	0.42	0.79	0.64	6
11.	Chitradurga	0.99	0.10	0.58	0.17	0.46	18
12.	Dakshina Kannada	0.93	0.32	0.38	0.86	0.63	7
13.	Davanagere	0.95	0.17	0.48	0.37	0.49	13
14.	Dharwad	0.93	0.08	0.92	0.69	0.66	4
15.	Gadag	0.98	0.07	1.00	0.57	0.65	5
16.	Kalaburgi	0.98	0.02	0.36	0.69	0.51	12
17.	Hasan	0.97	0.09	0.48	0.43	0.49	15
18.	Haveri	0.95	0.10	0.38	0.40	0.46	17
19.	Kodagu	1.00	0.40	0.27	1.00	0.67	3
20.	Kolar	0.94	0.05	0.05	0.13	0.29	29
21.	Koppal	0.97	0.04	0.49	0.25	0.44	20
22.	Mandya	0.95	0.04	0.52	0.09	0.40	24
23.	Mysuru	0.92	0.10	0.70	0.46	0.54	10
24.	Raichur	0.98	0.00	0.40	0.34	0.43	21
25.	Ramanagar	0.96	0.23	0.03	0.40	0.40	23
26.	Shivmogga	0.98	0.40	0.31	0.70	0.60	8
27.	Tumkur	0.97	0.03	0.30	0.22	0.38	26
28.	Udupi	0.95	0.34	0.28	0.79	0.59	9
29.	Uttara Kannada	1.00	1.00	0.16	0.95	0.78	1
30.	Yadgiri	0.98	0.06	0.54	0.12	0.42	22

The highest milk yield was found in Bidar (5.66 litres) followed by Kolar and Ramnagar with a milk yield of 5.12 and 5.07 litres, respectively.The annual per capita income was highest in Bengaluru Urban (Rs. 3,20,346) followed by Dakshina Kannada and Udupi with income of Rs.2,40,448 and Rs. 2,02,618. The lowest per capita income was found in Kalaburgi, Yadgiri and Bidar with an income of Rs. 65,493, 68,928 and 73, 892 respectively (Table 3).

Economic Efficiency Index ranges between 0.07 to 0.64 reflecting more economic inequality across the districts in the state of Karnataka. The Economic Efficiency is found to be highest in Bengaluru Urban with an index value 0.64 followed by Kolar and Bengaluru rural with an index of 0.64, 0.54 and 0.51 respectively (Table 4). It is due to the fact that the per capita income is more in Bengaluru Urban and rural as a result of more employment opportunities in these districts and Kolar is performing well in Economic efficiency because of higher milk yield and more income from subsidiary occupation i.e. dairy farming.

Social Equity plays an important role in sustainable livelihood security. The variables considered for social equity index are Female literacy rate, Maternal Mortality and percentage of population below poverty line. Female literacy rate ranges between 41.38 % to 84.13 %. The highest female literacy rate was found in case of Dakshina kannada (84.13 %) followed by Bengaluru Urban (84.01 %) and Udupi (81.58 %). The worst performing districts interms of female literacy rate are Yadagiri (41.38 %), Raichur (48.73%) and Chamarajnagara (54.92%). Population below poverty line is more in case of Chitradurga (46.7 %), Bellary (40.8 %), Koppala (40.7 %) and Yadagiri (38 %). The better performing or districts having less

Table 3. District wise data on different variables considered for economic efficiency

Sl. No.	Districts	Economic Efficiency Index		
		Net Sown Area	**Milk Yield**	**Per capita income**
01.	Bagalkot	71.31	2.82	121404
02.	Bengaluru Rural	47.10	4.76	139598
03.	Bengaluru Urban	19.05	5.08	320346
04.	Belagavi	60.63	3.15	82287
05.	Bellary	52.03	2.65	116807
06.	Bidar	57.67	2.63	73892
07.	Vijayapura	78.80	2.51	74741
08.	Chamarajnagara	26.92	4.02	99988
09.	Chickkaballapura	48.86	5.12	99600
10.	Chikkamagaluru	41.35	3.12	175179
11.	Chitradurga	51.27	2.82	88185
12.	Dakshina Kannada	29.83	3.92	240448
13.	Davanagere	65.79	3.37	89946
14.	Dharwad	77.86	3.20	114827
15.	Gadag	81.07	2.86	88942
16.	Kalaburgi	81.55	2.48	65493
17.	Hasan	55.53	3.55	115946
18.	Haveri	74.62	3.09	84629
19.	Kodagu	40.72	3.34	96939
20.	Kolar	44.71	5.66	98953
21.	Koppal	73.82	2.91	74134
22.	Mandya	44.16	4.17	129304
23.	Mysuru	55.04	3.90	100939
24.	Raichur	56.83	2.51	78057
25.	Ramanagar	43.17	4.01	126441
26.	Shivmogga	26.94	3.13	148979
27.	Tumkur	48.86	3.52	123803
28.	Udupi	27.21	3.44	202618
29.	Uttara Kannada	10.93	2.54	112902
30.	Yadgiri	58.04	2.50	68928
	Average	51.72	3.43	118475.17

Table 4. District wise economic efficiency index of Karnataka (India)

Sl.No.	Districts	Net Sown Area	Milk Yield	Per capita Income	EEI	Rank
01.	Bagalkot	0.86	0.11	0.22	0.39	10
02.	Bengaluru Rural	0.51	0.72	0.29	0.51	3
03.	Bengaluru Urban	0.12	0.82	1.00	0.64	1
04.	Belagavi	0.70	0.21	0.07	0.33	21
05.	Bellary	0.58	0.05	0.20	0.28	23
06.	Bidar	0.66	0.05	0.03	0.25	27
07.	Vijayapura	0.96	0.01	0.04	0.34	19
08.	Chamarajnagara	0.23	0.48	0.14	0.28	22
09.	Chickkaballapura	0.54	0.83	0.13	0.50	4
10.	Chikkamagaluru	0.43	0.20	0.43	0.35	17
11.	Chitradurga	0.57	0.11	0.09	0.26	25
12.	Dakshina Kannada	0.27	0.45	0.69	0.47	5
13.	Davanagere	0.78	0.28	0.10	0.38	14
14.	Dharwad	0.95	0.23	0.19	0.46	6
15.	Gadag	0.99	0.12	0.09	0.40	9
16.	Kalaburgi	1.00	0.00	0.00	0.33	20
17.	Hasan	0.63	0.34	0.20	0.39	13
18.	Haveri	0.90	0.19	0.08	0.39	12
19.	Kodagu	0.42	0.27	0.12	0.27	24
20.	Kolar	0.48	1.00	0.13	0.54	2
21.	Koppal	0.89	0.14	0.03	0.35	18
22.	Mandya	0.47	0.53	0.25	0.42	7
23.	Mysuru	0.62	0.45	0.14	0.40	8
24.	Raichur	0.65	0.01	0.05	0.24	28
25.	Ramanagar	0.46	0.48	0.24	0.39	11
26.	Shivmogga	0.23	0.20	0.33	0.25	26
27.	Tumkur	0.54	0.33	0.23	0.36	15
28.	Udupi	0.23	0.30	0.54	0.36	16
29.	Uttara Kannada	0.00	0.02	0.19	0.07	30
30.	Yadgiri	0.67	0.01	0.01	0.23	29

population under BPL are Kodagu (1.5 %), Bengaluru Urban (1.5 %), Dakshina Kannada (1.6 %) and Chamarajnagara (1.6 %) (Table 5).

Overall, in terms of social equity Bengaluru urban stands first with an index value 0.96 followed by Dakshina Kannada (0.93), Udupi (0.83) and Kodagu (0.80). The worst performing districts in terms of social equity are Raichur (0.12), Yadgiri (0.16), Koppal (0.18) and Bellary (0.20). The social equity index ranges between 0.12 to 0.96 indicating the wide variability in social equity across the districts in Karnataka (Table 6).

Table 5. District wise data on different variables considered for Social Equity

Sl. No.	Districts	Social Equity Index		
		Female literacy	Maternal Mortality	BPL
01.	Bagalkot	58.4	163	35.8
02.	Bengaluru Rural	70.63	120	15.7
03.	Bengaluru Urban	84.01	73	1.5
04.	Belagavi	64.58	155	28.8
05.	Bellary	58.09	227	40.8
06.	Bidar	61.55	134	35.1
07.	Vijayapura	56.72	135	23.1
08.	Chamarajnagara	54.92	142	1.6
09.	Chickkaballapura	61.55	94	25.2
10.	Chikkamagaluru	73.16	137	14.7

Sl. No.	Districts	Social Equity Index		
		Female literacy	Maternal Mortality	BPL
11.	Chitradurga	65.88	170	46.7
12.	Dakshina Kannada	84.13	89	1.6
13.	Davanagere	68.91	163	23.3
14.	Dharwad	73.46	157	34
15.	Gadag	65.44	215	21.8
16.	Kalaburgi	55.09	182	37.2
17.	Hasan	68.6	98	11.6
18.	Haveri	70.46	163	33.7
19.	Kodagu	78.14	138	1.5
20.	Kolar	66.84	140	10
21.	Koppal	57.55	236	40.7
22.	Mandya	62.54	111	16.4
23.	Mysuru	67.06	155	15.5
24.	Raichur	48.73	244	37.7
25.	Ramanagar	61.5	114	10.5
26.	Shivmogga	74.84	106	29.3
27.	Tumkur	67.38	124	13
28.	Udupi	81.58	50	22.4
29.	Uttara Kannada	78.39	99	19.6
30.	Yadgiri	41.38	186	38
	Average	66.05	144	22.89

Table 6. District wise social equity index of Karnataka (India)

Sl. No.	Districts	Female literacy	Maternal mortality	BPL	SEI	Rank
01.	Bagalkot	0.40	0.42	0.24	0.35	24
02.	Bengaluru Rural	0.68	0.64	0.69	0.67	7
03.	Bengaluru Urban	1.00	0.88	1.00	0.96	1
04.	Belagavi	0.54	0.46	0.40	0.47	20
05.	Bellary	0.39	0.09	0.13	0.20	27
06.	Bidar	0.47	0.57	0.26	0.43	22
07.	Vijayapura	0.36	0.56	0.52	0.48	19
08.	Chamarajnagara	0.32	0.53	1.00	0.61	14
09.	Chickkaballapura	0.47	0.77	0.48	0.57	16
10.	Chikkamagaluru	0.74	0.55	0.71	0.67	8
11.	Chitradurga	0.57	0.38	0.00	0.32	25
12.	Dakshina Kannada	1.00	0.80	1.00	0.93	2
13.	Davanagere	0.64	0.42	0.52	0.53	17
14.	Dharwad	0.75	0.45	0.28	0.49	18
15.	Gadag	0.56	0.15	0.55	0.42	23
16.	Kalaburgi	0.32	0.32	0.21	0.28	26
17.	Hasan	0.64	0.75	0.78	0.72	6
18.	Haveri	0.68	0.42	0.29	0.46	21
19.	Kodagu	0.86	0.55	1.00	0.80	4
20.	Kolar	0.60	0.54	0.81	0.65	10
21.	Koppal	0.38	0.04	0.13	0.18	28
22.	Mandya	0.49	0.69	0.67	0.62	13
23.	Mysuru	0.60	0.46	0.69	0.58	15
24.	Raichur	0.17	0.00	0.20	0.12	30
25.	Ramanagar	0.47	0.67	0.80	0.65	11
26.	Shivmogga	0.78	0.71	0.38	0.63	12
27.	Tumkur	0.61	0.62	0.75	0.66	9
28.	Udupi	0.94	1.00	0.54	0.83	3
29.	Uttara Kannada	0.87	0.75	0.60	0.74	5
30.	Yadgiri	0.00	0.30	0.19	0.16	29

Table 7. Sustainable livelihood security index of Karnataka (India)

Sl. No.	Districts	simple SLSI	Rank	WSLSI	Rank
01.	Bagalkot	0.38	24	0.377	21
02.	Bengaluru Rural	0.50	11	0.462	9
03.	Bengaluru Urban	0.59	2	0.361	22
04.	Belagavi	0.42	22	0.408	20
05.	Bellary	0.33	27	0.288	26
06.	Bidar	0.39	23	0.358	23
07.	Vijayapura	0.42	21	0.413	19
08.	Chamarajnagara	0.54	6	0.456	13
09.	Chickkaballapura	0.47	17	0.447	14
10.	Chikkamagaluru	0.55	5	0.509	4
11.	Chitradurga	0.34	26	0.325	25
12.	Dakshina Kannada	0.68	1	0.625	1
13.	Davanagere	0.47	18	0.460	10
14.	Dharwad	0.53	7	0.522	3
15.	Gadag	0.49	14	0.469	7
16.	Kalaburgi	0.38	25	0.354	24
17.	Hasan	0.53	8	0.501	5
18.	Haveri	0.44	20	0.434	17
19.	Kodagu	0.58	4	0.467	8
20.	Kolar	0.49	12	0.439	15
21.	Koppal	0.33	28	0.285	27
22.	Mandya	0.48	16	0.459	11
23.	Mysuru	0.51	10	0.497	6
24.	Raichur	0.26	30	0.205	29
25.	Ramanagar	0.48	15	0.457	12
26.	Shivmogga	0.49	13	0.415	18
27.	Tumkur	0.47	19	0.435	16
28.	Udupi	0.59	3	0.526	2
29.	Uttara Kannada	0.53	9	0.174	30
30.	Yadgiri	0.27	29	0.234	28

Simple SLSI is calculated by taking average of ecological security index, economic efficiency index and social equity index. The range of simple SLSI is from 0.26 to 0.68 and that of weighted SLSI is from 0.17 to 0.62 which indicate the wide variations in sustainable livelihood security across the districts due to ecological, social and economic variations. Dakshina Kannada district occupied first position in both simple SLSI and Weighted SLSI indicating the high level of sustainable livelihood security in the district with simple SLSI of 0.68 and WSLSI of 0.62. In case of simple SLSI better performing districts are Dakshina Kannada, Bengaluru Urban, Udupi and Kodagu and worst performing states are Raichur (0.26), Yadgiri (0.27), Koppal (0.33) and Bellary (0.33). In case of weighted SLSI better performing districts are Dakshina kannada, Udupi, Dharwad and Chikkamagaluru with WSLSI of 0.625, 0.526,0.522 and 0.509 respectively. The worst performing districts in WSLSI are Uttara kannada, Raichur, Yadgiri and Koppal. The better performing districts in both simple SLSI and weighted SLSI are Dakshina Kannada, Udupi and Chikkamagaluru whereas worst performing districts are Raichur, Yadagiri and Koppal which needs to be given priority in boosting the agricultural investment and overall development of districts in terms health, education and technology (Table 7).

5. CONCLUSION

The Sustainable Livelihood Security Index (SLSI) serves as a potent tool for assessing the essential conditions for sustainable development within a development planning framework. Districts showing poor performance in SLSI should be prioritized for agricultural investment, focusing on implementing new technologies, upgrading infrastructure, establishing food processing industries, and providing financial and marketing support. For districts with low scores in Ecological Security Index, emphasis should be on promoting agroforestry, afforestation, soil and water conservation, and expanding cultivated areas. However, even better-performing districts must concentrate on biodiversity conservation and ecological balance maintenance.

If a district's Economic Efficiency Index lags behind other indices, efforts should be directed towards enhancing agricultural productivity and creating more employment opportunities to ensure food and income security. Similarly, districts with lower scores in the Social Equity Index require heightened attention to education, healthcare, community participation, and rural infrastructure development.

SLSI not only identifies districts in need of immediate intervention but also pinpoints specific areas for focus within each region, aiding in targeted development planning. Addressing sustainability challenges can be facilitated by evaluating SLS status in specific regions. Continuously calculating SLSI over time enhances its applicability in solving sustainable development issues and evaluating the effectiveness of government programs aimed at agricultural and overall sustainable development.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Swaminathan MS. From Stockholm to Rio de Janeiro: the road to sustainable agriculture. MS Swaminathan Research Foundation, Centre for Research on Sustainable Agricultural and Rural Development; 1991.
2. FAO, Implications of economic policy for food security. Training material for Agricultural Planning, 40, Rome; 1997.
3. Empirical illustration from Vaishali district of Bihar, India. Agroecology and Sustainable Food Systems. 2020;38(1):46-68.
4. Suleiman RO, Adisa RS, Olaitan RT. Sustainable agriculture and rural livelihood security: A study of smallholder farmers' adaptation strategies in South-West Nigeria. Sustainable Development. 2020; 28(5):1203-1215.
5. Muktar MS, Uddin MB, Akhter S. Sustainable agricultural practices and livelihood security in developing countries: A case of Bangladesh. Sustainability. 2021; 13(6):3331.
6. Qureshi ASA, Kirbyshire A, Anwar MR. Enhancing climate resilience in agriculture and water resources management in South Asia: A review. Climate Risk Management. 2020;29:100236.
7. Sharma RK, Swarup A, Singh R. Sustainable Agriculture and Food Security: A Review. Indian Journal of Agricultural Sciences. 2020;90(1):30–39.
8. Sajjad H, Nasreen I, Ansari SA. Assessing spatiotemporal variation in agricultural sustainability Using Sustainable Livelihood Security Index; 2014.
9. Saleth RM. Agricultural sustainability status of the agro-climatic Sub-Zones of India: Empirical Illustration of Indexing Approach. Indian Journal of Agricultural Economics. 1993;48:543-550
10. Singh PK, Hiremath BN. Sustainable livelihood security index in Gujarat: A District Level illustration. Institute of Rural Management; 2008.
11. Ukaga U, Maser, C, Reichenbach M. Sustainable development: Principles, frameworks, and case studies. International Journal of Sustainability in Higher Education. 2011;12(2):207-222.
12. Kumar S, Ghosh A. Measuring Sustainable Livelihood Security: A Case of Indian States. Social Indicators Research. 2017; 134(1):29–48.
13. Chattopadhyay P, Ghosh S. Agricultural sustainability and rural livelihood security: An overview. Agricultural Economics Research Review. 2016;29(2):295–302.
14. Government of Karnataka, Economic Survey of Karnataka (2017-18), Directorate of Economics and Statistics, Bengaluru; 2018.
15. Hatai LD. Sen C. An economic analysis of agricultural sustainability in Orissa. Agricultural Economics Research Review. 2008;21:273-282.

16. Kareemulla K, Venkattakumar R, Manoj PS. An analysis on agricultural sustainability in India. Current Science. 2017;112(2):258-266.

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