Agricultural Economics Research Review
Vol. 30 (No.1) January-June 2017 pp 125-131
DOI: 10.5958/0974-0279.2017.00011.8

Estimating Agricultural Sustainability in Gujarat Using Sustainable Livelihood Security Index§

Mahima Gopal Ghabru[a], Ganga Devi[a]* and Ritambhara Singh[b]

[a]Department of Agriculture Economics, B.A. College of Agriculture,
Anand Agricultural University, Anand-388 110, Gujarat
[b]International Agri-Business Management Institute, AAU, Anand-338 110, Gujarat

Abstract

The paper has estimated agricultural sustainability in Gujarat by computing Sustainable Livelihood Security Index (SLSI) for 26 districts of the state using secondary data on various indicators under the ecology, economy and equity heads for the years 2001, 2011 and TE 2013-14. The study has found that in the year 2001, the district Surat (0.584) ranked first in SLSI, while Narmada (0.265) ranked the last. Later in the year 2011, Rajkot (0.589) ranked highest in SLSI, while Porbandar (0.257) ranked the lowest. During the TE 2013-14 too the districts Rajkot and Porbandar maintained their first and last ranks. The paper has suggested some measures for agricultural sustainability in the state in the years to come.

Key words: Sustainable agriculture, livelihood security, sustainability, livelihood security index, Gujarat

JEL Classification: Q01, Q56

Introduction

The origin of sustainability in development can be traced to the first UN conference on human development held in 1972 at Stockholm, when global consciousness on ecology, environment and poverty emerged. The sustainable development implies development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It is a symbiotic relation between humans and natural systems, and compatibility between ecology, economy and equity. Agriculture is one of the most aggressively managed ecosystems, and it has impact on global food system. Therefore, environment-friendly agriculture is a must for sustainability of humans and society. The sustainable agriculture can be considered as food production that integrates the goals of environmental health, economic efficiency and social equity (Sajjad *et al.,* 2014).

Agriculture is the main occupation in developing countries like India, where the majority of rural poor depend on it for income and livelihood. Therefore, sustainability of agriculture cannot be defined in isolation to the issue of livelihoods. Livelihood security means secured ownership of, or access to, resources and income-earning activities, including reserves and assets to offset risks, ease shocks and meet contingencies (Acharya, 2006). According to Chambers and Conway (1992), a livelihood is sustainable when it can cope with and recover from the stress and shocks, maintain its capability and assets, and provide sustainable livelihood opportunities for the next generation.

The inter-related dimensions of sustainability are ecology, economics and equity; therefore, to ensure sustainable development ecological security, economic

* Author for correspondence
Email: gangasaran1982@gmail.com

§ The paper is based on M.Sc thesis entitled 'Dimensions of Regional Disparity in Sustainable Agricultural Development in Gujarat' of the first author submitted under the guidance of second author to Anand Agricultural University, Anand.

efficiency and social equity are must. Ecological security is essential to preserve and develop the resource base of the economy. Economic efficiency provides guidance to use of resources (human and capital) under present technological conditions and social equity ensures a broad-based distribution of economic benefits both at present and in future, in the form of secured livelihoods, especially for socially and economically vulnerable groups.

Sustainable Livelihood Security (SLS), according to Swaminathan (1991) is livelihood options that are ecologically secure, economically efficient and socially equitable. It implies the protection or assurance of the means of livelihood for the masses not only at present but also in future. Sustainable Livelihood Security Index (SLSI) can help to identify whether necessary conditions for sustainable development exist in a given region/ecosystem or not. The main objective of the paper was to estimate agricultural sustainability in the state of Gujarat using Sustainable Livelihood Security Index and examine variations in it among different districts of the state with time, viz. 2001 to TE 2013-14.

Data and Methodology

A number of factors affect the sustainable development of an area, hence relevant and maximum available indicators were used in this study.The Sustainable Livelihood Security Index (SLSI) was calculated for 26 districts of Gujarat. The district-wise data were collected and compared for the years 2001, 2011 and TE 2013-14. The secondary data were collected from various published sources of Government of Gujarat; Directorate of Economics and Statistics, Gujarat, Directorate of Agriculture, Directorate of Animal Husbandry, National Dairy Development Board (NDDB), Statistical Abstracts of Gujarat State, Health Statistics, Directorate of Rural Development, etc.

The variables given below were grouped under the ecology, economy and equity heads and data were collected under these heads.

Ecological Security Indicators

The factors like population density, population growth, livestock density, area under forest, etc.were used to estimate the ecological security. The variables population density and population growth were selected as they are representative of the extent of human pressure on overall ecological security. Forest play a vital role in maintaining ecological balance and contribute significantly to economy. Both the economic and ecological functions of forest help people in sustaining their livelihoods. So, area under forest cover was selected for ensuring ecological security. To assess agricultural sustainability in the context of ecological security, cropping intensity and net irrigated area variables were selected. The livestock sector plays an important role in the socio-economic development of a nation. Therefore, livestock density was selected in view of its capacity to reflect the extent of animal pressure on the overall resources of environment. The net annual groundwater availability signifies its availability for present and future use and therefore, groundwater availability was also included in the variables.

The selected variables are enumerated below. The '+' and '–' signs indicate the positive impact and negative impact, respectively of the variables.

- Population density (per km^2) (-)
- Proportion of geographical area under forest (%) (+)
- Cropping intensity (%) (+)
- Livestock density (per km^2) (+)
- Net irrigated area (ha) (+)
- Population growth (%) (-)
- Net annual groundwater availability (ha-m) (+)

Economic Efficiency Indicators

The economic efficiency is represented by the variables like total foodgrain yield, total milk production, net sown area, etc. The foodgrain and milk yields not only capture the physical performance of soil productivity, biochemical technologies and yield of milch animals but also the potential for overall food and nutritional security of the districts. The net sown area represents the comparable agricultural land base for farm-based production systems. Optimum use of fertilizer at the opportune time is an essential ingredient for increasing agricultural productivity. So, the variable fertilizer consumption plays a crucial role in agricultural sustainability. The economic efficiency indicators along with signs are listed below:

- Total food grain yield (kg/ha) (+)
- Total milk production (tonne) (+)
- Net sown area (ha) (+)
- Fertilizer consumption (kg/ha) (-)
- Unemployment (+)

Social Equity Indicators

The social equity is evaluated by variables like percentage of population below poverty line, literacy rate, infant mortality rate, etc. The variable population below poverty line shows how equitably the resources are distributed across the population. The female literacy rate plays a vital role in the process of women empowerment and national development. The variable infant mortality rate reflects the picture of health awareness and availability of facilities in the society. The rural road connectivity is a crucial element of rural infrastructure scenario. Village electrification is an integral variable as lack of reliable electric supply hampers the growth impulses in different sectors of the economy. The number of bank branches and primary health centres show the access to basic amenities to people in the area. The selected indicator variables along with signs are listed below:

- Percentage of population below poverty line (%) (-)
- Literacy rate (%) (+)
- Female literacy rate (%) (+)
- Infant mortality rate (%) (-)
- Rural road connectivity (km per lakh of population) (+)
- Households electrified (%) (+)
- Number of commercial bank branches (per lakh population) (+)
- Number of primary health centres (per lakh population) (+)

The Sustainable Livelihood Security Index (SLSI) was computed based on three indices, viz. Ecological Security Index (ESI), Economic Efficiency Index (EEI) and Social Equity Index (SEI) using the ratio methodology given below:

$$SLSI_{ijk} = \frac{X_{ijk} - \min_k X_{ijk}}{\max_k X_{ijk} - \min_k X_{ijk}} \quad \ldots (1)$$

$$SLSI_{ijk} = \frac{\max_k X_{ijk} - X_{ijk}}{\max_k X_{ijk} - \min_k X_{ijk}} \quad \ldots (2)$$

where,

i = Variables (1, 2, 3, …..,i),

j = Components (1, 2, 3, …,j),

k = Districts 1, 2, 3,…….,k),

X_{ijk} = Value of the i^{th} variable, j^{th} component of k^{th} district, and

$SLSI_{ijk}$ = Value of index for the i^{th} variable representing the j^{th} component of the SLSI of k^{th} district, respectively.

Equation (1) is applicable to variables having positive implications for SLSI and Equation (2) is for variables having negative implications. The numerators in Equation (1) measure the extent by which the k^{th} district does better in the i^{th} variable representing the j^{th} component of its SLSI as compared to the region(s) showing worst performance. The denominator is the range, i.e. the difference between maximum and minimum values of a given variable across districts.

After calculating $SLSI_{ijk}$ for all variables, the indices for various components of SLSI were calculated as a simple mean of the three indices of their respective variables, i.e.

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

The three component indices of SLSI, viz. ESI, EEI and SEI were calculated by taking the equal weights of the indices of the respective representative variables. The SLSI, which is a composite index, was calculated by taking the arithmetic mean of its component indices. The values vary between 0 and 1. A value close to zero shows low level of sustainability and value close to 1 denotes high level of sustainability.

Results and Discussion

Sustainable Livelihood Security Index, 2001

The SLSI with its three component indices for different districts of Gujarat is presented in Table 1. In the year 2001, Surat had the highest ranking in SLSI (0.584), followed by Ahmedabad (0.475) and

Table 1. The values of Sustainable Livelihood Security Index (SLSI) for districts of Gujarat in 2001

District	Ecological Security Index	Rank	Economic Efficiency Index	Rank	Social Equity Index	Rank	Sustainable Livelihood Security Index	Rank
Kachchh	0.217	19	0.456	12	0.425	6	0.366	15
Banaskantha	0.579	2	0.630	1	0.173	24	0.461	7
Patan	0.221	17	0.378	20	0.226	22	0.275	23
Mehsana	0.454	3	0.548	7	0.408	7	0.470	4
Sabarkantha	0.429	5	0.499	10	0.247	21	0.392	12
Gandhinagar	0.453	4	0.455	13	0.513	5	0.474	3
Ahmedabad	0.360	12	0.367	21	0.697	1	0.475	2
Surendranagar	0.220	18	0.496	11	0.316	18	0.344	16
Rajkot	0.360	12	0.518	8	0.522	4	0.467	6
Jamnagar	0.227	16	0.406	17	0.371	12	0.335	18
Porbandar	0.176	22	0.410	16	0.312	19	0.299	21
Junagadh	0.385	8	0.553	5	0.370	13	0.436	9
Amreli	0.181	21	0.513	9	0.327	16	0.340	17
Bhavnagar	0.289	13	0.562	4	0.345	15	0.399	11
Anand	0.414	7	0.549	6	0.387	10	0.450	8
Kheda	0.376	10	0.604	2	0.323	17	0.435	10
Panchmahal	0.238	15	0.428	15	0.217	23	0.294	22
Dahod	0.375	11	0.353	22	0.076	25	0.268	24
Vadodara	0.427	6	0.447	14	0.530	2	0.468	5
Narmada	0.205	20	0.304	23	0.287	20	0.265	25
Bharuch	0.166	23	0.350	24	0.401	8	0.306	19
Surat	0.632	1	0.594	3	0.526	3	0.584	1
Tapi*	-	-			-	-	-	-
Dangs	0.275	14	0.235	25	0.385	11	0.298	20
Navsari	0.375	11	0.379	19	0.390	9	0.381	13
Valsad	0.381	9	0.383	18	0.351	14	0.371	14

*Tapi was formed in 2007

Gandhinagar (0.474). In this year, all these districts fared well in all the three dimensions (ecology, economic and social) of sustainability. But, their ranking was better in equity and economy than in ecology, as these districts were better in terms of provision of civic amenities and had better economic efficiency owing to better milk and foodgrain production. The low ranking districts in the state were Narmada, Dahod and Patan having an index value of 0.265, 0.268 and 0.275, respectively. These districts lagged behind in terms of equity and economy but had comparatively better ecological conditions than high ranking districts. The development in the state was taking a toll on ecological security as all high ranking districts did not hold high ESI values.

Sustainable Livelihood Security Index, 2011

A perusal of Table 2 indicates that the SLSI values for 2011 varied from 0.589 to 0.257. The results revealed that the highest SLSI ranking was of Rajkot (0.589), followed by Surat (0.524), Ahmedabad (0.523), Banaskantha (0.499) and Junagadh (0.496) which can be attributed to the high values of EEI followed by SEI and ESI values. Rajkot moved up in the ranking from sixth in 2001 to first in 2011, whereas Gandhinagar moved down from third in 2001 to thirteenth position in 2011. The results show that no district had comparatively high ESI value, which indicated that development was being done at the cost of ecological resources. Hence, ecological security

Table 2. The values of Sustainable Livelihood Security Index for districts of Gujarat during the year 2011

District	Ecological Security Index	Rank	Economic Efficiency Index	Rank	Social Equity Index	Rank	Sustainable Livelihood Security Index	Rank
Kachchh	0.270	15	0.451	11	0.355	16	0.359	17
Banaskantha	0.523	1	0.723	2	0.252	25	0.499	4
Patan	0.211	20	0.400	16	0.297	23	0.303	23
Mehsana	0.343	11	0.522	9	0.476	6	0.447	7
Sabarkantha	0.436	5	0.570	6	0.301	22	0.436	9
Gandhinagar	0.283	14	0.417	13	0.477	5	0.392	13
Ahmedabad	0.339	12	0.409	14	0.821	1	0.523	3
Surendranagar	0.211	20	0.615	4	0.313	21	0.380	14
Rajkot	0.402	7	0.780	1	0.586	3	0.589	1
Jamnagar	0.266	15	0.567	7	0.435	10	0.423	11
Porbandar	0.136	23	0.313	22	0.322	19	0.257	26
Junagadh	0.451	4	0.626	3	0.409	13	0.496	5
Amreli	0.185	22	0.589	5	0.333	18	0.369	15
Bhavnagar	0.307	13	0.548	8	0.382	15	0.412	12
Anand	0.432	6	0.450	12	0.444	8	0.442	8
Kheda	0.369	9	0.488	10	0.414	12	0.424	10
Panchmahal	0.353	10	0.387	18	0.292	24	0.344	19
Dahod	0.511	2	0.311	23	0.235	26	0.352	18
Vadodara	0.371	8	0.450	12	0.550	4	0.457	6
Narmada	0.200	21	0.258	24	0.321	20	0.260	25
Bharuch	0.128	24	0.334	19	0.458	7	0.307	22
Surat	0.501	3	0.405	15	0.666	2	0.524	2
Tapi	0.232	18	0.321	20	0.395	14	0.316	21
Dangs	0.224	19	0.229	25	0.354	17	0.269	24
Navsari	0.266	16	0.389	17	0.439	9	0.365	16
Valsad	0.245	17	0.314	21	0.433	11	0.331	20

demands special attention in all the districts. Porbandar (0.257), Narmada (0.260), Dangs (0.269), Patan (0.303) and Bharuch (0.307) were the low ranking districts. The districts like Dahod and Panchmahal have revealed high ESI values owing to their tribal status, but these districts ranked low in their EEI and SEI values which showed that these districts require special attention in terms of economy and equity. Singh and Hiremath (2008) conducted a district level study on Sustainable Livelihood Security Index in Gujarat and found that Surat ranked first and Dahod ranked last in the SLSI ranking.

The equity and economy need special attention in the resource-poor districts of Gujarat; hence, steps must be taken to provide better technical knowhow in these areas through KVKs, and extension and information services to boost productivity of crops as well as livestock. The government institutions must come forth to provide better civic facilities to these areas and on the other hand, districts which are enjoying high development must be monitored to not cause damage to natural resources.

Sustainable Livelihood Security Index, TE 2013-14

There has been a slight change in the ranking of ecological security in the TE 2013-14 vis-a-vis 2011 (Table 3). Surat (0.515), Banaskantha (0.505), Dahod (0.466) and Rajkot (0.452) were the high ranking districts in ESI while Bharuch ranked lowest with an

Table 3. The values of Sustainable Livelihood Security Index for districts of Gujarat during TE 2013-14

District	Ecological Security Index	Rank	Economic Efficiency Index	Rank	Social Equity Index	Rank	Sustainable Livelihood Security Index	Rank
Kachchh	0.268	20	0.466	12	0.349	15	0.361	18
Banaskantha	0.505	2	0.773	1	0.255	24	0.511	4
Patan	0.177	23	0.395	16	0.297	22	0.290	23
Mehsana	0.400	7	0.535	8	0.479	5	0.471	6
Sabarkantha	0.423	6	0.615	4	0.311	20	0.449	8
Gandhinagar	0.273	19	0.453	13	0.467	6	0.398	13
Ahmedabad	0.374	10	0.433	14	0.830	1	0.546	2
Surendranagar	0.200	22	0.627	3	0.317	19	0.381	15
Rajkot	0.452	4	0.773	1	0.535	4	0.587	1
Jamnagar	0.280	16	0.551	7	0.419	10	0.417	11
Porbandar	0.105	25	0.315	21	0.318	18	0.246	25
Junagadh	0.430	5	0.647	2	0.398	12	0.492	5
Amreli	0.209	21	0.577	5	0.341	17	0.376	16
Bhavnagar	0.275	18	0.553	6	0.373	14	0.401	12
Anand	0.397	8	0.484	10	0.446	7	0.442	9
Kheda	0.354	12	0.524	9	0.417	11	0.432	10
Panchmahal	0.385	9	0.406	15	0.286	23	0.359	19
Dahod	0.466	3	0.324	19	0.204	25	0.331	21
Vadodara	0.356	11	0.474	11	0.538	3	0.456	7
Narmada	0.279	17	0.249	22	0.301	21	0.276	24
Bharuch	0.155	24	0.325	18	0.430	9	0.303	22
Surat	0.515	1	0.438	13	0.639	2	0.531	3
Tapi	0.338	13	0.333	17	0.376	13	0.349	20
Dangs	0.321	15	0.206	23	0.345	16	0.290	23
Navsari	0.328	14	0.406	15	0.433	8	0.389	14
Valsad	0.354	12	0.316	20	0.417	11	0.362	17

index value of 0.155. The districts Rajkot and Banaskantha (0.773) ranked first in economic efficiency owing to improvement in foodgrain yield, milk production and reduced unemployment levels while, Dangs (0.206) ranked last. There has been no change over the three years in social equity from 2011, as Ahmedabad (0.830) ranked highest and Dahod (0.204) ranked lowest as per SEI values. The results in Table 3 show that Rajkot maintained its first rank over the TE 2013-14 in SLSI ranking with a value of 0.587, followed by Ahmedabad (0.546), Surat (0.531), Banaskantha (0.511) and Junagadh (0.492). The high ranking of these districts in SLSI was due to their high EEI and SEI values. Porbandar (0.246), Narmada (0.276), Dangs (0.290) and Patan (0.290) were low performing districts in SLSI ranking due to their low values in equity, ecology and economy. Therefore, development in these districts can be considered less sustainable. Pal *et al*. (2015) have studied the dynamics of agricultural development in Gujarat using the Prem Narain methodology (Narain *et al.,* 2002) and categorized districts of Gandhinagar, Banaskantha, Mehsana, Surat, Anand, Kheda and Junagadh as the high-developed districts; Bhavnagar, Porbandar and Panchmahal, as medium-developed; and Amreli, Surendranagar, Dahod, Bharuch, Dang and Patan as low-developed districts in agricultural status.

Conclusions

The Government of Gujarat has played an important role in developing infrastructure like irrigation, power, roads, etc. Gujarat has achieved significant strides in agriculture through modernization, diversification, good infrastructure for production and marketing. The huge public investment on agricultural development, industrial development, irrigation projects, improved crop varieties, extension services, dissemination of technologies through Krushi Mahotsav, Kisan gosthi, Kisan melas, on-campus and off-campus trainings, issue of Soil Health Cards have all been the positive steps towards increasing agricultural productivity in the state. The state has achieved double digit agricultural growth, but this growth needs to be sustainable in the years to come. Evidently, regional disparity exists among districts of Gujarat in terms of ecology, economy and equity. Over the years, none of the districts has been found efficient in all the three indicators, especially ecological indicators which show continuance of huge pressure on natural resources. Therefore, the ecological resources need to be used adequately. The tribal districts of the state lag behind in provision of better civic amenities and hence efforts must be directed towards increasing the economy and social equity of these districts.

Policy Measures

The government should focus on dissemination of micro-irrigation, high-value crops, market institutions and extension and information service institutions. Efficient water management through micro-irrigation systems, reducing wide fluctuations in agricultural productivity and prices, checking distress sales and rising cultivation cost, increasing agricultural exports and dissemination of modern technologies and agricultural innovations are some of the important sectors that need immediate attention of the government.

References

Acharya, S.S. (2006) Sustainable agriculture and rural livelihoods. *Agricultural Economics Research Review*, **19**(2): 205-217.

Chambers, R. and Conway, G.R. (1992) *Sustainable Rural Livelihoods: Practical Concepts for the 21st Century*. Discussion Paper 296. Institute of Development Studies, University of Sussex, Brighton, England.

Narain, P., Sharma, S.D., Rai, S.C. and Bhatia, V.K. (2002) Dimensions of regional disparities in socio-economic development of Madhya Pradesh. *Journal of Indian Society of Agricultural Statistics*, **55**(1): 88-107.

Pal, V., Shiyani, R.L. and Ardeshna, N.J. (2015) Dynamics of agricultural development in Gujarat: A district level analysis. *Indian Journal of Economic Development,* **11**(1): 351-358.

Sajjad, H., Nasreen, I. and Ansari, S.A. (2014) Assessing spatiotemporal variation in agricultural sustainability using Sustainable Livelihood Security Index: Empirical illustration from Vaishali district of Bihar, India. *Agroecology and Sustainable Food Systems*, **38**(1): 46-68.

Singh, P.K. and Hiremath, B.N. (2008) *Sustainable Livelihood Security Index in Gujarat*: *A District-Level Illustration*. Working Paper 205. Institute of Rural Management (IRMA).

Swaminathan, M.S. (1991) *From Stockholm to Rio de Janeiro*: *The Road to Sustainable Agriculture*. Monograph No. 4. MS Swaminathan Research Foundation, Chennai.

Received: April, 2016; Accepted: November, 2016