

## RESEARCH ARTICLE



# Agricultural diversification in Sikkim: A move towards organic high-value agriculture

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## Abstract

**Objective:** To inspect the extent and nature of diversification in the agricultural sector in the Indian state of Sikkim from the initiation of the Organic Mission (2003) to the attainment of full organic status (2016) by the state. **Methods:** Compound Annual Growth Rate (CAGR) is computed to understand the pace and pattern of agricultural development and the Simpson Diversity Index (SID) and the Percentage Share of different crops in the Total Cropped Area are calculated to measure the extent of diversification. **Findings:** The CAGR in terms of both area and production were found to be positive for high-value crops whereas traditional agricultural crops recorded negative growth in the same period. The value of SID at 0.81 implies a high degree of diversification towards high-value agriculture in Sikkim.

**Keywords:** Agriculture; diversification; Sikkim; organic; high-value agriculture

## 1 Introduction

In the Indian context, crop diversification is generally viewed as a shift from traditionally grown less profitable crops to more profitable crops and it is intended to give a wider choice in the production of a different variety of crops in a given area to increase production-related activities on various crops and also to reduce the risk<sup>(1)</sup>. The agro-climate of Sikkim is congenial for the cultivation of a wide variety of seasonal and off-season vegetables, fruits, spices, and floriculture so the diversification towards High-Value Agricultural (HVA) crops could be used as a measure towards utilization of the untapped potential the state possesses.

In Sikkim agriculture and allied field activities serves as the backbone of the rural population and their overall security. Agriculture is practiced in approximately 11 percent of the total area of the state and about 64 percent of the population depends on the same. The net cultivated area is 80,000 hectares including the large cardamom fields<sup>(2)</sup>. Kharif is the main season for the cultivation of agricultural crops in the state. The location of Sikkim provides optimum conditions for the cultivation of a wide range of agricultural and horticultural crops. The agro-climate varies from subtropical to alpine and no single crop or variety can suit all the elevation ranges so crop diversification and mixed farming are practiced. Rainfall in the state is quite high and agriculture is predominantly rain-fed in the state.<sup>(3)</sup>

Self-sufficiency in food grain production remains unattainable for Sikkim due to its limited area under cultivation and due to the presence of a large number of small farms. Due to the impending food scarcity, the practice of importing food grains under the Public Distribution System is practiced in Sikkim and this has further reduced the public expenditure on agriculture. The present situation of importing food grains is further going to increase rural poverty, both from the nutritional point of view as well as in terms of declining employment opportunities in rural areas<sup>(4)</sup>.

So, from the perspective of poverty reduction and employment generation, diversification is necessary for Sikkim. Diversification towards HVA Crops could be the solution for a small state like Sikkim where the agriculture sector is characterized by a large number of small landholders. The characteristic feature of most of the high-value food commodities are, they are labour-intensive, they have low gestation periods, and generate quick returns. So, diversification towards HVA crops offers a perfect opportunity for smallholders to utilize surplus labour and increase their incomes<sup>(5)</sup>.

Although agricultural practices have always been traditional and organic in Sikkim, in 2003 a major announcement was made by the Sikkim state government to fully adopt organic means of agriculture production. Sikkim organic mission was initiated in 2003 and launched in 2010 with a target area of 74,303 ha to be brought under organic certification. As of 2015, Sikkim achieved an organic certification area of 76169.604 ha with 66,227 farmers and 191 growing groups practicing organic cultivation<sup>(6)</sup>. In 2016 Sikkim was declared as the first organic state of India in terms of agriculture production.

Against this backdrop, the objective of this paper is to inspect the extent of diversification in the agricultural sector in Sikkim from the initiation of the organic mission to the attainment of full organic status by the state.

## 2 Materials and Methods

The organic mission was initiated in Sikkim in 2003 and it attained full organic status in 2016, so the study covers the period of 14 years (2003-2016). Secondary data for the study were collected from the database of Forest and Environment Department, Government of Sikkim<sup>(7)</sup>, Spices Board of India<sup>(8)</sup>, and Reserve Bank of India<sup>(9)</sup>. This paper considers diversification as a shift from low-value staples to high-value crops. Compound Annual Growth Rate (CAGR) is computed to understand the pace and pattern of agricultural development and the Simpson Diversity Index (SID) and the percentage share of different crops in the total cropped area are used as a measure for the extent of diversification.

### 2.1 Compound Annual Growth Rates (CAGR)

The compound growth rates were computed to understand the pace and pattern of growth in the agricultural sector. To estimate the compound growth rate following formula was used:

$$\log Y = a + \beta t \quad (i)$$

Where,

Y = Area and production

a = Intercept

t = Time

$\beta$  = Slope coefficient

The annual compound growth rate (s) is calculated by the following formula:

$$\text{Growth Rate} = (\exp(\beta) - 1) * 100 \quad (ii)$$

### 2.2 Estimation of Diversification

The percentage share of different crops to the total cropped area was calculated to estimate the changes over the period of the study. The contribution of each crop to overall growth in the crop sector is estimated by using the following formula:

$$S_i = \frac{A_{it}}{A_t} * 100 \quad (iii)$$

Where,

$S_i$  = percentage share of 'i'th crop in the overall cropped area.

$A_{it}$  = area of 'i'th crop in time period 't'.

$A_t$  = total area under agricultural production in time period 't'.

Simpsons Diversity Index (SID) was calculated to assess the extent of diversification in the agricultural sector in Sikkim during the period of study. SID shows the dispersion of commodities in a geographical region. The index ranges between 0 and 1. In the case of complete specialization, the index moves towards 0 and in the case of complete diversification, the index moves to 1.

$$SID = 1 - \sum_{i=1}^n P_i^2 \quad (iv)$$

Where,

$SID$  = the Simpson Index of Diversity

$P_i$  = the proportionate area of  $i^{th}$  crop in the gross cropped area.

### 3 Results and Discussion

#### 3.1 Share of different sectors in the State Gross Domestic Product (GSDP) :

The share of different sectors in State Gross Domestic Product is summarised in [Table 1]. Agriculture and allied activities accounted for about 21.45 percent in the total share of State Gross Domestic Product (GSDP) for the year 2003 but there has been a gradual decline in its share in the following years. In the year 2016 its share in the GSDP is just 7.60 percent. The fall in the share of the agriculture sector is juxtaposed to the growth in the secondary sector.

**Table 1.** Share of different sectors in GSDP (2003-2016).

Year	Share of agriculture and allied activities	Share of Industry	Share of Tertiary sector
2003	21.45	28.57	49.96
2004	20.54	30.21	49.23
2005	19.72	31.57	48.69
2006	16.80	28.68	54.50
2007	16.67	30.12	53.19
2008	14.70	35.90	49.37
2009	8.52	56.27	35.19
2010	8.31	60.99	30.69
2011	11.37	60.64	27.98
2012	10.74	60.61	27.63
2013	10.34	62.61	27.04
2014	8.40	59.90	31.70
2015	8.00	61.20	30.80
2016	7.60	62.30	30.10

Source: Authors calculation from CSO data on State Domestic Product and Directorate of Economics, Statistics, Monitoring, and Evaluation (Govt. Of Sikkim)

The share of the secondary sector has risen from 28.57 percent in 2003 to 62.30 percent in 2013. Although in terms of GSDP in current prices the contribution of crops has increased the increase has been outweighed by the increase in the contribution of the secondary sector. The growth in the secondary sector is mainly due to the growth of manufacturing and construction<sup>(10)</sup>. The share of the tertiary sector has also decreased in the period 2003-16 but the decrease has been gradual. Tourism services are the major contributor to the share of the tertiary sector. Although there has been a fall in the contribution of agriculture and allied activities it remains the highest contributor in terms of employment generation.

#### 3.2 Compound Annual Growth Rates(CAGR) :

**Table 2.** Compound annual growth rates of area and production of various crops for the study period (2003-2016).

CROPS	CAGR (AREA) (%)	CAGR (PRODUCTION) (%)
FRUITS	6.63	8.17
VEGETABLES	3.78	5.90
SPICES	1.13	4.40
PADDY	-2.89	-0.90
WHEAT	-24.69	-26.62
MAIZE	0.38	1.34
MILLET	-3.64	-2.40
BARLEY	-7.17	-8.81
BUCKWHEAT	5.52	8.30
PULSES	-1.02	-1.28
OILSEEDS	-2.68	-0.75

Source: Authors calculation from Reports of Forest and Environment Department, Government of Sikkim, Spices Board of India, and Reserve Bank of India.

Compound annual growth rates (CAGR) for the various crops in terms of area and production were calculated for the period 2003 to 2016. It is evident from [Table 2] that horticultural crops namely fruits, vegetables, and spices all have a positive CAGR in terms of both area and production. Fruits have the highest CAGR with 6.63 percent and 8.16 percent in terms of area and production respectively. Large cardamom is the major spice grown in Sikkim and it contributes significantly to the total production of large cardamom in India. CAGR of spices in terms of area is 1.13 percent and in terms of production is 4.40 percent in Sikkim for the study period. Vegetable production, which is the main source of income generation for the rural population also shows positive growth in the study period. In terms of area, the CAGR for vegetables is 3.78 percent and 5.90 percent in terms of production.

During the period of the study majority of the traditional agriculture crops such as paddy, wheat, millet, barley, etc show a negative CAGR in terms of both area and production. Only maize and buckwheat record a positive CAGR for both area and production. CAGR in the area is 0.38 percent and 1.34 percent in production for maize and buckwheat records an impressive 5.52 percent CAGR in area and 8.30 percent CAGR in terms of production. Buckwheat is considered a super food due to its nutritional value and comes under the category of High-Value Agricultural crops.

From [Table 3], for the study period total horticultural crops have a CAGR of 3.06 percent for the area and 5.72 percent in terms of production. Total cereals record a negative CAGR of -1.33 percent in terms of area but a negative CAGR of -0.12 percent for production. Total pulses record a CAGR of -1.02 percent and -1.28 percent for area and production respectively. Total food grains and total oil seeds also record a negative CAGR for the study period.

**Table 3.** Compound annual growth rates of area and production of total horticultural and agricultural crops for the study period (2003-2016).

CROPS	CAGR (AREA) (%)	CAGR (PRODUCTION) (%)
TOTAL HORTICULTURAL CROPS	3.06	5.72
TOTAL CERIALS	-1.33	-0.12
TOTAL PULSES	-1.02	-1.28
TOTAL FOODGRAINS	-1.60	-0.28
TOTAL OIL SEEDS	-2.70	-0.80

Source: Authors calculation from Reports of Forest and Environment Department, Government of Sikkim, Spices Board of India, and Reserve Bank of India

### 3.3 Share of different crops in Total Cropped Area and SID in the different year:

**Table 4.** Percentage share of different crops in total area and SID in different years (2003-2016).

Year	SID	Paddy	Wheat	Maize	Millet	Barley	Pulses	Buckwheat	Vegetables	Spices	Fruits
2003	0.83	11.42	4.45	28.43	3.21	0.95	5.20	1.56	12.47	24.56	7.75
2004	0.82	11.49	4.47	28.60	3.23	0.96	5.23	1.57	13.25	24.81	6.39
2005	0.83	11.78	4.59	29.34	3.32	0.98	5.44	1.61	14.07	21.76	7.11
2006	0.82	11.59	5.23	33.46	3.39	0.94	4.88	1.67	14.58	16.89	7.37
2007	0.82	11.43	3.64	32.66	3.05	0.58	5.39	1.67	16.41	17.59	7.59
2008	0.83	10.22	3.07	30.83	2.96	0.39	4.62	4.36	16.91	18.37	8.26
2009	0.83	9.27	3.93	29.85	3.21	0.76	4.91	4.19	16.25	18.42	9.22
2010	0.82	8.59	1.87	28.41	2.12	0.45	4.74	3.10	20.30	18.04	12.38
2011	0.82	9.01	1.88	30.00	2.63	0.49	5.09	3.75	17.95	19.15	10.06
2012	0.81	8.95	0.39	30.02	2.24	0.44	4.78	2.67	18.78	20.67	11.04
2013	0.81	8.24	0.27	29.50	2.19	0.43	4.65	2.68	19.28	20.93	11.82
2014	0.81	7.95	0.28	28.01	2.21	0.41	4.51	2.35	21.02	21.21	12.06
2015	0.81	8.21	0.25	29.99	2.20	0.44	4.37	2.75	15.63	22.69	13.47
2016	0.81	7.45	0.18	27.38	1.86	0.32	3.86	2.54	18.14	25.33	12.94

Source: Authors calculation from Reports of Forest and Environment Department, Government of Sikkim, Spices Board of India, and Reserve Bank of India

The share of different crops in the total cropped area calculated for the study period is presented in [Table 4] and [Figure 1]. Rice, maize, and spices had the majority share in the total cropped area in the year 2003. Maize had the highest share of 28.43 percent, spices had a share of 24.56 percent, and rice had a share of 11.42 percent in the total cropped area. Over the years, during the period of the study, the percentage share of maize in total area cropped has remained fairly uniform. In 2016 the share of maize stood at 27.38 percent. Even though maize is not the staple diet of the people of this region, it

is mostly consumed as dhenro (boiled maize rice) in the rural areas<sup>(11)</sup>. According to the publication by the Department of Horticulture, Sikkim 35 percent of the production of maize is used for human consumption while 50 percent of the production is used for poultry and cattle feed<sup>(12)</sup>. Due to the ban on the use of chemical fertilizers agricultural households depend on livestock for manure. The fair share of maize in the total cropped area can be attributed to the fact that it is commonly used as feed for the livestock which plays an important role in the agriculture of Sikkim as a source of organic fertilizer.

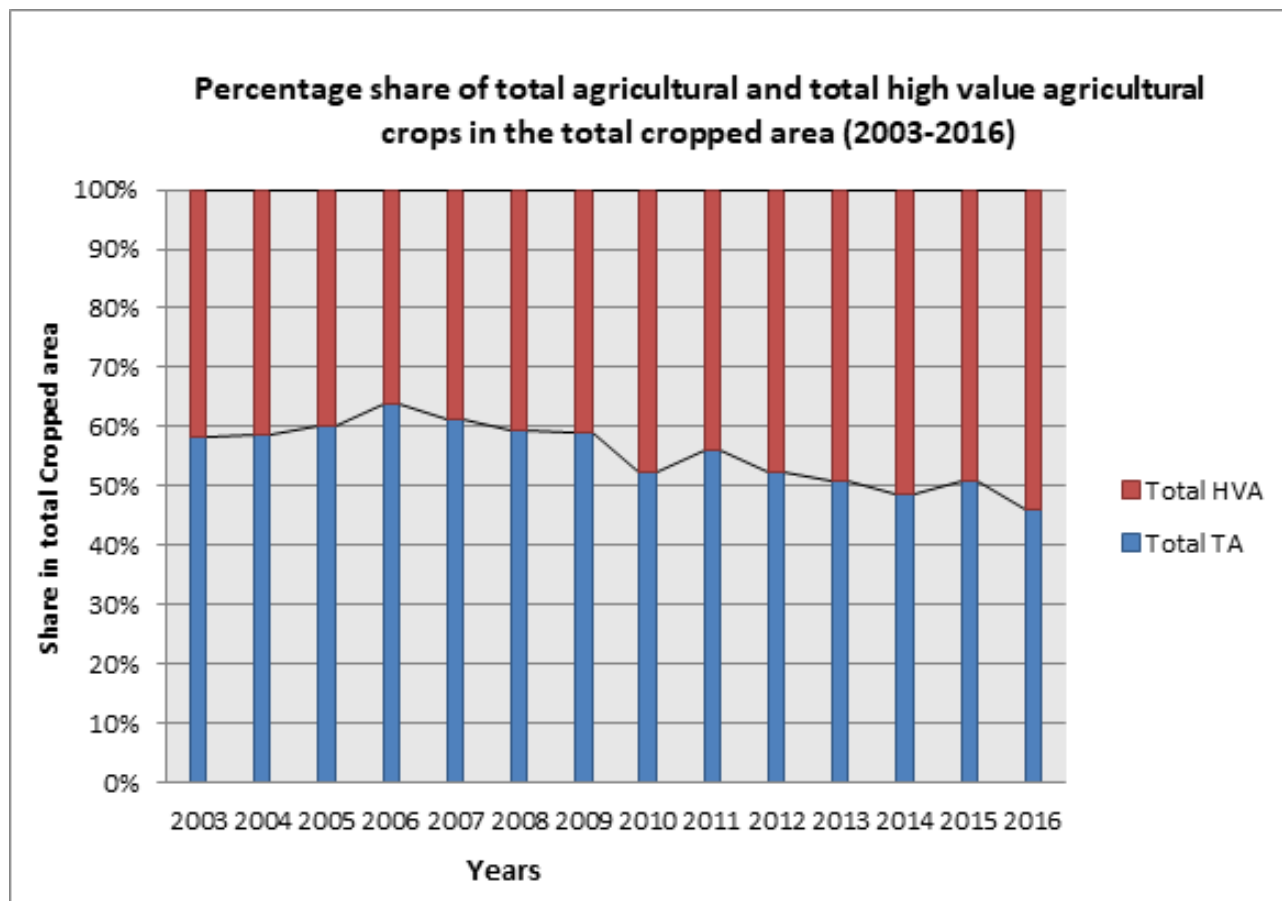


Fig 1. Here, Total HVA= Total High Value Agricultural crops Total TA= Total Traditional Agricultural Crops

Source: Authors calculation from reports of Forest and Environment Department, Government of Sikkim, Spices Board of India, and Reserve Bank of India

Although rice is the staple for the majority of the population in Sikkim its share in the total cropped area has seen a considerable decrease to 7.45 percent in 2016. Sikkim relies predominantly on imports of rice under the Public Distribution System (PDS) and from the neighbouring state of West Bengal. Also, 76.63 percent of the operational landholdings are small and marginal<sup>(13)</sup> which does not favour commercial rice cultivation.

The share of spices in the total area also decreased in the study period to 25.33 percent in 2016 but the decrease has been negligible. Large cardamom, ginger, chilli, turmeric, and coriander are the spices grown in Sikkim but large cardamom constitutes the major share in total spices production and area. Sikkim contributes significantly to the total national production of large cardamom and even globally it contributes around 50 percent of the total production of large cardamom<sup>(14)</sup>. The high international prices of large cardamom aids in providing economic sustainability to the farmers in Sikkim.

The share of other agricultural crops viz, wheat, millet, barley, and pulses have all decreased during the study period except the share of buckwheat which has increased. Buckwheat is a cash crop that fetches more price than rice. The maturity time for buckwheat is only a month, it requires low input, its ability to grow in poor soil leaving low residue it becomes a strong contender of crop rotation. Buckwheat also comes under the category of high-value crop and hence the shift in the production from other traditional agricultural crops to buckwheat could be interpreted as a shift towards the production of high-value crops.

The share of horticultural crops in the total cropped area has also seen a considerable increase in the study period. The share of fruits increased from 7.75 percent in 2003 to 12.94 percent in 2016. The share of vegetables increased from 12.47

percent and 18.14 percent in the same period. With respect to Sikkim, horticulture has a number of advantages compared to agriculture crops. First, it's more remunerative and horticulture can be done on dry and hilly land. Water utilisation is lower and the risk of crop failure is also lower for the horticultural crop. Horticultural farms can be much smaller where marginal farmers can earn a livelihood from their small landholdings unlike in the case of large-scale cereal farming.

During the study period, the value of SID has remained fairly constant at 0.83 in 2003 to 0.81 in 2016. The value of SID close to 1 implies that the agricultural sector in Sikkim was diversified during the period of initiation of Organic Mission. The value of SID at 0.81 in 2016 implies that during the attainment of the full organic status high degree of diversification in Sikkim persisted. In terms of both CAGR and proportionate share in the total cropped area, High-value crops like fruits, vegetables, spices, and buckwheat have shown positive growth in comparison to traditional agricultural crops. This implies a high degree of diversification in agriculture has sustained in the study period and agricultural practices in Sikkim have moved towards organic High-Value Agriculture.

## 4 Conclusion

The results of the study suggest that there is a presence of a high degree of diversification in the agricultural sector in Sikkim. With the adoption of the policy of only organic means of production, the agricultural sector is gradually diversifying towards the production of high-value crops. The adoption of High-Value cash crops particularly fruit and vegetable crops has an advantage in mountainous regions like Sikkim, firstly it helps in the productive use of the marginal lands and second, it also helps to maintain the ecology and environment. In an economic sense, it helps in commercializing the small farms. So, the diversification towards HVA and organic mission in Sikkim has been going abreast.

In recent years there has been a growth in demand for high-value crops in the domestic as well as the global market. Sikkim being a tourism hotspot the demand for HVA crops is also very high at the state level. The diversification towards HVA crops is further going to aid Sikkim in income and employment generation. For further sustainable progress of agricultural diversification, the state government has to take series of reform measures to integrate production and markets, provide technical training to the farmers, improve transportation and warehousing facilities, improve thrust on agriculture in terms of investment and planning and increase the area coverage of HVA crops in the state.

## Financial disclosure/Conflict of interest

The authors declare that there was no financial aid received and no conflict of interest associated with this research work.

## References

- 1) Lalrinsangpuii MR. Agriculture diversification in North Eastern Region of India. *International Journal of Economics, Commerce and Research*. 2016;5:5–12. Available from: <https://www.scribd.com/document/324772006/2-Ijecd-Agricultural-Diversification-in-North>.
- 2) Government of Sikkim. 2020. Available from: <http://www.sikkimagrisnet.org>.
- 3) Government of India. State of Environment Report Sikkim 2007. Ministry of Environment and Forests. . Available from: <http://www.sikkimforest.gov.in>.
- 4) Chakrabarti A. A critical review of Agrarian Reforms in Sikkim. *Economic and Political Weekly*. 2010;30:23–26. Available from: <https://www.jstor.org>.
- 5) BIRTHAL PS, JOSHI PK, ROY D, THORAT A. Diversification in Indian agriculture towards high-value crops. *Intl Food Policy Res Inst*; 2007. 2007.
- 6) Government, Sikkim. [6]Government of Sikkim. Organic farming: Back to the Roots. Integrating Organic farming & Tourism in Sikkim. 2020. Available from: <https://darpg.gov.in/>.
- 7) Sikkim GO, Hub. 2020. Available from: [http://sikenvis.nic.in/Database/Agriculture\\_777.aspx](http://sikenvis.nic.in/Database/Agriculture_777.aspx).Dateaccessed.
- 8) Government of India. Ministry of Commerce and Industries, Spices Board of India. 2020. Available from: <http://indianspices.com/>.
- 9) Handbook of Statistics on Indian States. 2020. Available from: <https://m.rbi.org.in/Scripts/AnnualPublications.aspx?head=Handbook+of+Statistics+on+Indian+States>.Dateaccessed.
- 10) Government of Sikkim. 2020. Available from: <http://www.desme.in/page/7>.
- 11) Tamang JP, Thapa N, Thapa S, Rai B. Food Consumption in Sikkim with special reference to Traditional Fermented Foods and Beverages: A Micro Level Study. *Journal of Hill Research*. 2007. Available from: <https://www.researchgate.net/>.
- 12) Government, Sikkim. . Available from: <http://www.sikkim-horti.org>.
- 13) Agriculture Census 2015-16. . Available from: <http://agcensus.nic.in>.
- 14) Engineers India Research Institute. Project Report on Processing Unit of Large Cardamom. . Available from: <https://www.eiriindia.org/>.