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- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

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SPATIO-TEMPORAL ANALYSIS OF CROP DIVERSIFICATION IN HIMACHAL PRADESH: A DISTRICT WISE ANALYSIS

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ABSTRACT
This paper analyzes the district wise crop diversification crop concentration scenario in the north Indian hilly state of Himachal Pradesh. The study is based on the analysis of relevant time series data of 39 years (1972-73 to 2010-11) collected from different official sources. The study suggests that farmers in the state are adjusting their cropping patterns to incorporate a higher mix of high value crops; particularly fruits and vegetables. It has been noticed that this trend is more prevalent in districts having batter irrigation facilities; hence other districts were found to be having relatively low cropping intensity. Further, Bilaspur, Hamirpur and Kangra district had higher concentration of cereals and pulses. Farmers of almost all districts were concentrating on cultivation of maize and wheat. However, favorable agroclimatic conditions and related infrastructural facilities were noticed to influence farmers' changing interest in fruits and vegetables, of course apart from the fact of economic superiority of these farm activities. The paper suggests that for promoting crop diversification the state would require working on a larger canvass to take note of effective dissemination of production and marketing related technical knowledge to the farmers.

KEYWORDS
Gibbs-Martin Index, coefficient of variation, crop concentration index, diversification, spatio-temporal variation.

INTRODUCTION
Diversification implies an extension in different directions from a given point. In agriculture, diversification is a strategy to cultivate a number of crops or take different farm enterprises to improve upon the current situation; in terms of profitability of the farm business. Such an approach is important for agrarian economies like India where the livelihood of more than 50 per cent of the population is directly or indirectly dependent on agriculture. Diversification of farming leads to changes in product or enterprise choices and thus improvements in incomes via increased production and optimal input use decisions based on market forces and principles of profit maximization (Pingali and Rosegrant, 1995). The strategy of crop diversification intends to give a wider choice in production on a variety of crops in a given area so as to expand production related activities on various crops and also to lessen risk and maximize the use of resources such as land, water and other critical inputs for the overall agricultural development. It is also an important strategy to increase farm income, stabilize its flow, generate employment, increase efficiency of resource utilization, provide food and nutritional security, alleviate poverty and for conservation of soil and water resources (Von Braun 1995; Pingali and Rosegrant 1995; Ramesh Chand 1996; Rayn and Spencer 2001; Birthal et.al, 2007; Kumar and Singh, 2013). Because crop diversification allows many viable opportunities to farmers to cultivate different crops on their farms therefore in that respect it is a sort of indirect insurance against different climatic and biological risks affecting monoculture. Agricultural sustainability and profitability is declining owing to increase in cost of cultivation and decrease in farm income (Singh, 2004; Sidhu et al. 2010) and diversification can be of help in this regard.

Diversification of agriculture in the hill region is important for the farmers who often cultivate marginal lands on steep slopes. Fragile ecosystems of the hills also do not support cropping systems that are heavy on agronomic practices. Himachal Pradesh is an important hill state in western Himalayan region that has emerged as a model in remunerative farming. This has been possible by taking a well thought out digression from the traditional subsistence farming and modifying the farming systems by incorporating fruits, vegetables, flowers and lately medicinal & aromatic plants. However, notwithstanding the improvements in farming, the pressures on farm lands are also visible in the state because of many non-agricultural development initiatives. To maintain commercial viability of the farm sector, introduction of improved farm technologies, crops and farm enterprises ensuring complementarities and efficient resource use are still needed. Therefore, farm incomes can only be enhanced and maintained through further introduction of high value crops and through adoption of diversified cropping schemes. Diversification thus would help in broadening and strengthening of the income sources of rural households (Barghouti et al., 1990) and it is also expected to help in ecological improvements.

MATERIAL AND METHODS
This paper analyzes the district wise spatio-temporal variation in crop diversification and concentration of selected crops in Himachal Pradesh. The study is based on the time series data collected from the state Directorate of Land Records, Directorate of Horticulture, Directorate of Agriculture and the Directorate of Economics & Statistics. The data used for analyzing spatio-temporal variation in crop diversification and the concentration index pertains to the period 1972-73 to 2010-11. In recent years many researchers have used Gibbs-Martin Index for measuring diversification (Datta, 2012; Das and Mili, 2012; Wen, 2010; Subedi, 2012; Lujan and Gabriels, 2005). In the present study also the Gibbs-Martin Index (GMI) has been used for analyzing crop diversification. This index was preferred over the other indices like Herfindahl Index, Ogive Index, Entropy Index and Modified Entropy Index as they explain diversification of crops in a given time and space by single indicator (Islam and Rahman, 2011). This method has an advantage over other methods as the Index can be calculated without reducing the actual statistics to percentages. The value of the Index varies between 0 to 1; where 0 implies specialization or the growing of a single crop. Any value higher than this indicates diversification; thereby the higher value of the index is directly related to higher magnitude of diversification. It provides a method of generalizing the relationship between the relative strength and number of crops grown. The formula is as under:

$$GMI = 1 - \frac{\sum_{i=1}^{N} X_i^2}{(\sum X_i)^2}$$

Where,

GMI	=	Gibbs-Martin Index of diversification in cropping pattern
X	=	Area under individual crop or percentage of total cropped area occupied by each crop

For calculating the crop concentration index for the study areas the following formula has been used. The high index value represents high concentration and low value shows lower level of the concentration.

$$\text{Crop Concentration Index } (Cx) = \frac{\frac{A_{ij}}{A_j}}{\frac{\sum_{i=1}^{n} Y_{ij}}{\sum_j Y_j}}$$

Where,

A_{ij}	=	Area under ith crop in jth district
A_j	=	Gross cropped area in the jth district
$\sum_j Y_{ij}$	=	Area under ith crop in the State
$\sum_j Y_j$	=	Gross cropped area in the State

Coefficient of Variation (CV) has been calculated as follows.

$$CV = \frac{\text{Standard Deviation}}{\text{Mean}} X\ 100$$

RESULT AND DISCUSSION

Traditionally, agriculture has been the mainstay of the economy of Himachal Pradesh; where agriculture included fruit growing and animal rearing as well. Over time these components of farming have become relatively specialized and there is perceptible change in their levels and composition. As per the revenue records, the net area sown in the state was 19.06% of the total geographical area (558562 ha) of the state in the year1972-73 immediately after Himachal got the statehood. Presently, (2010-11) the net sown area accounts for about 11.28% of the total geographical area (938615 ha), which has also increased because of precise measurements. Although the reported geographical area increased by 56.11 percent over 1972-73 the net area sown declined by 2.74 percent over 1972-73 figures. The gross cropped area during this period increased by just one percent; indicating thereby a marginal decrease in the net cropped area. The compound growth rate for net area sown worked out to be 0.13 percent whereas for gross cropped area it was 0.04 percent (Table 1). The coefficient of variations of net area sown, gross cropped area and cropping intensity worked out to be 2.77, 2.12 and 2.28 respectively; suggesting thereby not much of changes in these indicators over time.

The districts wise analysis indicated that net area sown during the period of analysis increased in Lahaul & Spiti (41.38%), Kullu (17.76 %), Chamba (3.96%), Mandi (3.50 %) whereas in the rest of the districts the net area sown in 2010-11 registered negative change over 1972-73 figures. The compound growth rate of net area sown was found to be positive only in L&S, Kullu, Kangra and Chamba districts whereas, in rest of the districts it was negative. In gross cropped area the compound growth rates were found negative in Kinnaur, Shimla, Sirmaur and Solan whereas rest of the districts there was positive growth. The compound growth rates of cropping intensity were negative only in Kinnaur, Lahaul & Spiti and Shimla and cropping intensity is seen to have increased in rest of the districts of the state. The coefficient of variation for the proportion of net sown area for the districts ranged from 2 to 9; while the CV value ranged between 2 to 11 for cropping intensity and gross cropped area. This indicates moderate level of disparities amongst different districts in these indicators.

TABLE 1: DISTRICTS WISE CATEGORIES ON THE BASIS OF THEIR SHARE TOWARDS NET AREA SOWN, GROSS CROPPED AREA AND CROPPING INTENSITY & COMPOUND GROWTH RATE (1972-73 TO 2010-11)

Districts	Percent Change in 2010-11 over 1972-73			Compound Growth Rate (%)		
	Net Area sown	Gross cropped area	Cropping Intensity	Net Area sown	Gross cropped area	Cropping Intensity
Bilaspur	-4.91 (3.08)	6.14 (6.68)	11.62 (6.96)	-0.20	0.17	0.37
Chamba	3.96 (2.35)	12.87 (6.83)	8.57 (6.62)	0.10	0.33	0.23
Hamirpur	-10.38 (6.43)	-3.41 (10.41)	7.78 (11.04)	-0.47	0.08	0.55
Kangra	-6.67 (3.95)	-5.42 (4.80)	2.44 (4.39)	0.01	0.22	0.21
Kinnaur	-0.28 (4.90)	-8.51 (9.59)	-8.25 (5.83)	-0.24	-0.61	-0.37
Kullu	17.76 (4.42)	15.68 (7.97)	-1.66 (5.43)	0.33	0.58	0.25
L&S	41.38 (7.91)	40.57 (9.34)	-0.58 (8.29)	0.60	0.42	-0.18
Mandi	3.50 (4.49)	10.17 (4.73)	6.44 (4.88)	-0.12	0.21	0.33
Shimla	-1.02 (4.71)	-16.95 (8.26)	-16.10 (6.10)	-0.16	-0.57	-0.42
Sirmaur	-4.37 (3.14)	3.31 (2.32)	8.02 (2.46)	-0.24	-0.06	0.17
Solan	-11.77 (8.37)	-4.70 (5.07)	8.00 (5.46)	-0.47	-0.20	0.28
Una	-7.72 (5.83)	12.58 (4.20)	22.00 (7.61)	-0.37	0.16	0.54
HP	-2.74 (2.77)	1.00 (2.12)	3.84 (2.28)	-0.13	0.04	0.18

Note: co-efficient of variation in parenthesis

The analysis indicated that Kangra, Mandi and Shimla district were contributing more than 10 percent towards net area sown, whereas this proportion was low in case of Kinnaur and L&S. The contribution of other districts in this regards can be categorized as medium with the range of contribution of 5 to 10 percent of the total net area sown of the state. Categorization of district on the basis of their share towards net area sown of Himachal Pradesh is presented in Table 2.

TABLE 2: CATEGORIZATION OF DISTRICT ON THE BASIS OF THEIR SHARE TOWARDS NET AREA SOWN OF THE HP

Category	Percent share of net sown area of the state	Districts
High	>10	Kangra, Mandi, Shimla
Medium	5 to 10	Bilaspur, Chamba, Hamirpur, Kullu, Sirmaur, Solan, Una
Low	< 5	Kinnaur, Lahaul & Spiti

Categorization of districts on the basis of cropping intensity (Table 3) shows that Bilaspur, Hamirpur, Kangra, Mandi, Sirmour and Una had a higher cropping intensity (>173) while rest of the districts were having lower cropping intensity when benchmarked on the state average. Analysis shows that cropping intensity did not increase too much over the period of analysis, it increased by 6 per cent during this period. One indication of relatively high or low cropping intensity in different districts is the availability of crucial resource of irrigation. The districts which have low cropping intensity generally rely on rainfall and also that average agroclimatic conditions of these areas generally allow taking one crop during the year, as parts of these areas remain under snow for quite some time during the year. Also, in many districts a large number of farmers have diverted their lands towards fruits crops.

TABLE 3: CATEGORIZATION OF DISTRICT ON THE BASIS OF CROPPING INTENSITY

Category	Range (CI)	Districts
High	> 173	Bilaspur, Hamirpur, Kangra, Mandi, Sirmaur and Una
Low	<173	Chamba, Kinnaur, Kullu, Lahaul & Spiti, Shimla and Solan

An analysis of the share of a crop in total cropped area in a district was done to visualize the importance of different crops and the results are presented in Table 4. The table presents the results for the two points of time i.e. 1972-72 and 2010-11 although the analysis covers the entire period between these two spatial points across districts. The table shows that the total cropped area in the state increased by about 2.06% indicating thereby, on an average, almost stable cropping efforts being put by the farmers in the state. The position in 1972-73 also reveals that about 83.44 percent of the cropped area was under cereals and another about 17 per cent area was under other crops. Among cereals wheat, maize and paddy were covering more than 73 percent of the gross cropped area. The situation in 1982-83 revealed that area under these three crops contributed nearly 79 percent of the total cropped area and more or less the similar trend was noticed during 1992-93 and 2002-03. The gross cropped area however declined from 975433 ha in 2002-03 to 938625 ha in 2010-11. This clearly revealed that these three crops dominate the cropping pattern of the state. The share of total cereal crops increased in 1982-83 and after that it showed a declining trend. The area under fruits crops, vegetable crops, spices showed an increasing trend during the period under study.

The district wise analysis revealed that the contribution of Kangra district towards total cropped area of the state was more than 20 percent during the periods under study followed by Mandi, Shimla, Sirmaur and Una districts. The contribution of Kangra district towards main cereal crops cultivated in the state was higher than remaining districts of the state in all the periods. Shimla district dominated the scenario in case of apple, potato and vegetable crops followed by Kullu. Contribution of Sirmaur district was highest in case of spices followed by Kullu. The data were further analyzed for different periods (I, II, III, IV and V) to understand the contribution of different districts of the state towards selected crops under study and the results are presented in Table 5. A cursory glance of the table shows that Kangra district, followed by Mandi and Sirmaur districts, accounts for more than 35 percent of the total area under paddy in the state. In case of maize, the range of maize acreage during the period under study is 16 percent to 20 percent of the total area under maize cultivation in the state and in this case the district is followed by Mandi, Hamirpur, Una, Solan and Sirmaur respectively. In case of wheat Kangra and Mandi contributed near about 45 percent of the total area under wheat in the state. Apple is seen to be the dominant fruit crop in Shimla and Kullu district with the share of more than 80 percent, followed by Kinnaur, Mandi, and Chamba districts respectively. In other fruits, which are mostly subtropical fruits, the contribution of Kangra, Kullu and Mandi was more that 55 percent of the area under this group of fruits in the state. Shimla, Mandi, Kullu, Kangra contribute more than 70 percent of the total area under potato and vegetable cultivation. The contribution of Sirmaur was highest in the field of spices cultivation in the state, followed by Kullu, Mandi and Shimla. This analysis suggests the continuity of cultivation of various cereal and other crops by the farmers of the state over a long period of time indicating the suitability of the crops for the areas or may be the resource constraints to make drastic changes in the cropping pattern. The issue needs to be analyzed in detail from these angles to for better understanding and planning for agriculture in the state.

TABLE 4: DISTRICT WISE SHARE OF IMPORTANT CROPS TOWARDS TOTAL CROPPED (TCA) AREA OF HIMACHAL PRADESH (in %age)

							1972-73								
Items	Maize	Paddy	Wheat	Barley	Other cereals	Total pulses	Apple	Other fruits	Potato	Other vegetable	Cardamom and spices	Oilseed	Fodder crops	Other Crops	TCA
HP	28.12	10.65	31.66	4.59	8.25	7.84	1.28	0.53	1.58	0.51	0.33	2.60	0.99	1.09	919706
Bilaspur	2.28	0.40	2.05	0.02	0.00	0.90	0.00	0.01	0.00	0.04	0.01	0.07	0.01	0.03	5.83
Chamba	2.28	0.31	2.05	0.67	0.45	0.35	0.00	0.03	0.04	0.02	0.01	0.28	0.00	0.02	6.53
Hamirpur	2.76	0.61	2.14	0.02	1.39	0.59	0.00	0.00	0.00	0.02	0.00	0.04	0.00	0.04	7.51
Kangra	5.77	4.34	9.60	0.55	0.13	1.41	0.00	0.09	0.21	0.01	0.01	1.55	0.45	0.43	24.52
Kinnaur	0.03	0.00	0.17	0.29	0.63	0.03	0.01	0.04	0.04	0.00	0.00	0.00	0.00	0.00	1.20
Kullu	1.26	0.39	1.87	0.73	0.66	0.32	0.14	0.00	0.12	0.02	0.01	0.06	0.00	0.02	5.60
L&S	0.00	0.00	0.05	0.12	0.04	0.02	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.01	0.27
Mandi	3.93	2.78	2.69	0.61	3.19	0.63	0.28	0.11	0.11	0.12	0.02	0.11	0.04	0.15	15.85
Shimla	2.21	0.62	3.52	0.98	1.54	0.50	0.80	0.00	0.92	0.18	0.02	0.02	0.00	0.00	11.32
Sirmaur	2.53	0.53	2.94	0.39	0.22	0.56	0.05	0.15	0.08	0.02	0.21	0.12	0.05	0.12	7.96
Solan	2.45	0.38	2.20	0.19	0.01	1.20	0.01	0.07	0.02	0.03	0.04	0.26	0.16	0.13	7.13
Una	2.62	0.28	2.36	0.00	0.00	1.32	0.00	0.00	0.00	0.05	0.00	0.08	0.27	0.13	7.15
							2010-11								
Items	Maize	Paddy	Wheat	Barley	Other cereals	Total pulses	Apple	Other fruits	Potato	Other vegetable	Cardamom and spices	Oilseed	Fodder crops	Other Crops	TCA
HP	31.62	8.21	38.11	2.39	0.89	3.65	6.59	1.43	1.19	2.01	0.79	1.69	0.90	0.53	938625
Bilaspur	2.86	0.16	2.82	0.02	0.00	0.02	0.00	0.04	0.00	0.05	0.02	0.06	0.03	0.00	6.06
Chamba	2.97	0.37	2.22	0.40	0.14	0.41	0.19	0.04	0.09	0.04	0.01	0.33	0.00	0.00	7.22
Hamirpur	3.36	0.20	3.57	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.01	0.01	0.03	0.00	7.21
Kangra	6.20	4.01	9.96	0.33	0.02	0.33	0.00	0.63	0.14	0.05	0.02	0.55	0.18	0.30	22.72
Kinnaur	0.02	0.00	0.02	0.10	0.14	0.18	0.51	0.05	0.01	0.11	0.01	0.00	0.00	0.00	1.13
Kullu	1.80	0.16	2.05	0.33	0.11	0.37	0.89	0.15	0.13	0.18	0.09	0.07	0.00	0.00	6.35
L&S	0.00	0.00	0.00	0.05	0.01	0.19	0.02	0.00	0.08	0.00	0.00	0.00	0.00	0.01	0.37
Mandi	5.22	2.08	7.15	0.37	0.14	0.69	0.51	0.17	0.26	0.22	0.07	0.11	0.07	0.05	17.11
Shimla	1.11	0.14	1.16	0.36	0.29	0.76	4.41	0.06	0.31	0.49	0.06	0.04	0.01	0.00	9.21
Sirmaur	2.27	0.65	2.80	1.16	0.05	0.43	0.06	0.12	0.08	0.43	0.44	0.14	0.22	0.13	8.06
Solan	2.55	0.22	2.63	0.18	0.00	0.24	0.00	0.08	0.01	0.38	0.06	0.16	0.13	0.01	6.65
Una	3.27	0.20	3.73	0.00	0.00	0.03	0.00	0.08	0.07	0.04	0.00	0.21	0.23	0.03	7.89

TABLE 5: SHARE OF DISTRICT IN TOTAL AREA SOWN UNDER VARIOUS CROPS IN HIMACHAL PRADESH

							1972-73								
Items	Maize	Paddy	Wheat	Barley	Other cereals	Total pulses	Apple	Other fruits	Potato	Other vegetable	Cardamom and spices	Oilseed	Fodder crops	Other Crops	TCA
HP	258579	97912	291165	42178	75856	72136	11802	4841	14505	4694	3036	23945	9070	9987	919706
Bilaspur	8.10	3.76	6.47	0.54	0.01	11.49	0.00	2.33	0.06	6.90	2.50	2.75	1.22	3.20	5.83
Chamba	8.10	2.94	6.47	14.69	5.49	4.44	0.23	5.85	2.84	4.43	2.11	10.94	0.09	1.99	6.53
Hamirpur	9.83	5.76	6.77	0.51	16.83	7.47	0.00	0.14	0.13	4.77	0.56	1.34	0.36	3.48	7.51
Kangra	20.52	40.81	30.32	12.08	1.61	18.02	0.00	17.66	13.18	1.34	3.10	59.63	45.61	39.54	24.52
Kinnaur	0.11	0.04	0.55	6.42	7.60	0.40	1.14	7.52	2.70	0.60	0.07	0.03	0.00	0.16	1.20
Kullu	4.47	3.66	5.90	15.82	7.95	4.08	10.85	0.66	7.56	4.71	3.99	2.42	0.09	2.08	5.60
L&S	0.00	0.00	0.16	2.52	0.45	0.28	0.02	0.00	2.35	0.19	0.00	0.07	0.00	0.58	0.27
Mandi	13.98	26.09	8.51	13.20	38.62	8.08	21.54	21.17	6.91	23.43	4.64	4.16	4.41	13.92	15.85
Shimla	7.86	5.83	11.13	21.37	18.66	6.43	62.05	0.00	58.24	35.75	7.21	0.70	0.07	0.24	11.32
Sirmaur	9.00	4.95	9.28	8.60	2.63	7.12	3.63	28.24	4.77	3.30	63.80	4.74	5.33	11.18	7.96
Solan	8.70	3.53	6.96	4.21	0.13	15.34	0.55	12.83	1.28	5.43	11.96	9.98	15.76	11.67	7.13
Una	9.33	2.64	7.46	0.05	0.02	16.84	0.00	3.59	0.63	9.14	0.07	3.25	27.07	11.95	7.15
							2010-11								
Item	Maize	Paddy	Wheat	Barley	Other cereals	Total pulses	Apple	Other fruits	Potato	Other vegetable	Cardamom and spices	Oilseed	Fodder crops	Other Crops	TCA
HP	296814	77027	357673	22450	8382	34271	61891	13453	11159	18870	7391	15834	8446	4964	938625
Bilaspur	9.03	1.95	7.39	0.67	0.00	0.45	0.00	3.14	0.11	2.37	2.38	3.42	2.91	0.28	6.06
Chamba	9.39	4.55	5.82	16.73	15.26	11.30	2.94	2.77	7.73	1.88	1.28	19.82	0.51	0.04	7.22
Hamirpur	10.62	2.48	9.36	0.20	0.16	0.04	0.00	0.74	0.06	1.06	1.19	0.37	2.95	0.40	7.21
Kangra	19.61	48.83	26.13	13.98	2.20	9.04	0.01	43.95	12.17	2.46	2.18	32.68	19.86	57.21	22.72
Kinnaur	0.05	0.02	0.05	4.16	15.15	4.92	7.66	3.38	0.88	5.41	0.95	0.01	0.00	0.20	1.13
Kullu	5.68	1.97	5.39	13.94	12.73	10.04	13.51	10.61	10.91	9.02	11.98	4.39	0.31	0.00	6.35
L&S	0.01	0.00	0.01	1.91	1.10	5.28	0.31	0.11	6.70	0.24	0.00	0.18	0.00	1.89	0.37
Mandi	16.49	25.29	18.76	15.66	15.63	18.99	7.77	11.95	22.22	10.81	8.89	6.51	8.04	9.07	17.11
Shimla	3.52	1.76	3.04	15.25	32.37	20.92	66.95	4.13	25.86	24.55	7.67	2.17	0.67	0.08	9.21
Sirmaur	7.19	7.94	7.36	10.11	5.39	11.70	0.84	8.32	6.88	21.39	55.55	8.30	24.62	24.40	8.06
Solan	8.07	2.72	6.91	7.39	0.00	6.66	0.01	5.49	0.57	18.99	7.37	9.69	14.34	1.23	6.65
Una	10.34	2.49	9.78	0.00	0.02	0.74	0.00	5.41	5.91	1.81	0.55	12.48	25.80	5.20	7.89

GROWTH IN CROP ACREAGE

The pattern of rate of change in crop acreage over time has been analyzed with the help of compound growth rates for change in area under a given crop. The entire study period (1972-73 to 2010-11) has been considered for this analysis as well. The results of the analysis are presented in Table 6. It is evident from the table that the compound growth rate of area under maize, wheat, apple, other fruits, other vegetables, spices, fodder crops and other crops was positive whereas rest of the crops under study showed negative growth rate for the area under these crops. The highest growth rate was recorded in area under the category of 'other fruits' (peach, plum apricot, mango, citrus, litchi, pear and dry fruits etc), followed by apple and vegetables, excluding potato. In case of cereals, the highest growth rate under maize was recorded in L&S district followed by Mandi, Bilaspur, Hamipur, Kangra, Kullu and Una. The compound growth rate of area under paddy was found to be positive only in Sirmaur district, indicating a general shift of area under this crop to other crops. This seems to be the result of labour intensive nature of the crops as well as the declining water availability for irrigation. Kinnaur, L&S, Shimla and Sirmaur districts recorded negative growth rate in wheat crop as well. The compound growth rate for barley indicated that area under this crop during last 39 years registered a declining trend in all the districts except Solan where it increased but at a lower rate of 0.02 percent per annum. The area under vegetable crops in all the districts showed increasing trend during this period and the highest growth under vegetables was recorded in L&S (12.82 % per annum) followed by Sirmaur, Mandi, Kullu, Solan, Bilaspur, Chamba, Kinnaur and Kangra, where it registered more than 2 percent.

TABLE 6: DISTRICT WISE COMPOUND GROWTH RATE OF AREA UNDER VARIOUS CROPS IN HIMACHAL PRADESH- 1972-73 TO 2010-11

Districts	Crop & Compound growth rate										
	Maize	Paddy	Wheat	Barley	Other cereals	Total pulses	Apple	Other fruits	Potato	Other veg	TCA
Bilaspur	0.59	-3.13	0.78	-1.37	0.81	-9.97	0.97	4.66	0.38	3.47	0.04
Chamba	0.34	-0.36	0.54	-1.67	-2.59	-0.09	9.27	1.12	1.23	3.41	0.21
Hamirpur	0.58	-3.16	0.54	-3.03	-11.25	-14.70	Nil	6.32	-1.63	0.10	-0.24
Kangra	0.52	0.01	0.63	-1.70	-3.07	-3.35	-2.44	5.91	2.06	2.07	0.06
Kinnaur	-1.20	-1.21	-5.40	-2.61	-3.53	5.88	8.67	1.33	-3.55	3.16	-0.58
Kullu	0.78	-2.39	0.88	-1.54	-6.67	0.10	4.56	7.24	0.90	4.67	0.58
L&S	3.90	Nil	-5.82	-2.56	-1.12	0.23	13.13	7.33	0.08	12.82	0.55
Mandi	0.80	-0.88	0.75	-1.23	-4.95	-1.04	0.73	3.70	1.17	5.43	0.18
Shimla	-1.74	-3.77	-3.04	-2.47	-3.89	0.55	4.93	16.60	-2.00	4.03	-0.52
Sirmaur	-0.29	0.39	-0.60	-0.98	-0.97	-1.17	-0.48	2.16	1.31	8.03	0.05
Solan	-0.09	-0.51	0.52	0.02	-8.66	-4.35	-3.24	1.48	-2.48	4.38	-0.23
Una	0.50	-0.18	0.83	-9.14	-2.55	-9.31	Nil	6.56	6.71	1.26	0.14
HP	**0.31**	**-0.67**	**0.24**	**-1.72**	**-4.58**	**-2.67**	**4.24**	**4.52**	**-0.13**	**2.08**	**0.05**

CROP DIVERSIFICATION

The district wise crop diversification in the state is presented in Table 7. It is evident from the table that crop diversification in Himachal Pradesh declined from 1972-73 (0.78) to 2010-11 (0.75). The decrease in the GMI index value is directly related with increase in the area under few crops at the cost of others. The crops (fruits, vegetables and spices) which have become more profitable in due course of time with the introduction of high yielding varieties and also better cultivation techniques, and assured market through market intervention schemes in the state have recorded considerable increase in the area. Rationalization of such cropping system has been largely facilitated by the expansion and intensification of small scale irrigation facilities and use of seed fertilizer technology as an essential input for increasing the agriculture production. The increase in area under these crops occurred at the cost of decrease of area of low value crops like other cereals, barley, pulses and paddy. Taking into consideration the GMI values, the districts which have higher values than the Gibb's Martin index value for the state were considered highly diversified districts. In all the periods under study, except 2010-11, Shimla and Kullu (except in 1992-93) come out as the most diversified districts with GMI ranging between 0.83 (1972-73) to 0.43 (2010-11). After 1992-93 Sirmaur district also joined the category of most diversified district. The Gibb's Martin index value of Mandi was higher than the value of the state in 1972-73 only. The GMI value of Kinnaur district increased from 0.67 to 0.77 in 2002-03. In the year 1972-73 Mandi and Shimla were the only districts falling under the category of highly diversified. In 1982-83 Shimla, Kullu was having higher Gibb's Martin index value than the state. In 1992-93 Sirmaur, Shimla L&S, Kinnaur, Kangra were having higher Gibb's Martin index value as compared to the average Gibb's Martin index value of the state. In 2002-03 Sirmaur, Shimla, Kullu, Kinnaur were having more Gibb's Martin index value. The Gibb's Martin index value of Sirmaur, Kullu was higher as compared to the value for the state. The overall picture that emerges from the above analysis is that Bilaspur, Hamirpur, L&S and Una districts have tendency towards crop specialization. A spatio-temporal analysis of crop diversification from 1972-73 to 2010-11also shows that Solan, Sirmaur, Shimla, Mandi, Kullu and Kinnaur districts are highly diversified districts in the state.

TABLE 7: DISTRICT WISE CROP DIVERSIFICATION (GMI) IN HIMACHAL PRADESH

Districts	Years and GMI			
	1972-73	1982-83	1992-93	2002-03
Bilaspur	0.71	0.66	0.68	0.62
Chamba	0.75	0.73	0.73	0.71
Hamirpur	0.74	0.61	0.56	0.57
Kangra	0.75	0.72	0.78	0.71
Kinnaur	0.68	0.71	0.77	0.78
Kullu	0.80	0.76	0.71	0.79
L&S	0.74	0.74	0.77	0.69
Mandi	0.82	0.74	0.72	0.71
Shimla	0.84	0.79	0.84	0.84
Sirmaur	0.75	0.73	0.74	0.82
Solan	0.76	0.72	0.71	0.72
Una	0.72	0.64	0.62	0.61
HP	**0.78**	**0.74**	**0.74**	**0.75**

CROP CONCENTRATION

The data were further analyzed to find out the crop concentration in various districts of the state. Crop concentration refers to the variation in the density of crops cultivated in an area at a given point of time. The agroclimatic conditions of the area are considered to be important factors influencing it. From the results presented in the table (Table 8) it is clear that in the district where specialization towards fruit crops and vegetables is taking place, mostly the area share of low value food grain crops like barley, other minor cereal crops, pulses and oilseed is low. The concentration of growing cereals and pulses throughout the period was higher in Bilaspur, Hamirpur, Kangra districts as compared to other districts of the state. The overall analysis of the growth of area under various crops had shown negative growth rate in barley, other cereals, potato and oilseeds during the last 39 years in the state. Almost all the districts concentrated on the cultivation of maize and wheat crops, but in the district where agroclimatic conditions and suitable infrastructural facilities were available farmers have started concentrating on high value crops such as fruits and vegetables.

TABLE 8: CROP CONCENTRATION INDEX IN HIMACHAL PRADESH (1972-73 AND 2010-11) (in ratio)

Crops/ District	Maize		Paddy		Wheat		Barley		Other Cereal		Pulses		Apple	
	1972-73	2010-11	1972-73	2010-11	1972-73	2010-11	1972-73	2010-11	1972-73	2010-11	1972-73	2010-11	1972-73	2010-11
Bilaspur	1.39	1.46	0.65	0.36	1.03	1.22	0.09	0.18	0	0.21	1.99	0.05	0	0
Chamba	1.24	1.29	0.45	0.62	0.92	0.79	2.27	2.33	0.94	2.22	0.69	1.48	0.04	0.41
Hamirpur	1.31	1.48	0.77	0.34	0.83	1.31	0.07	0.02	3.13	0.03	1	0.01	0	0
Kangra	0.84	0.91	1.68	2.25	1.14	1.21	0.5	0.65	0.09	0.11	0.74	0.42	0	0
Kinnaur	0.09	0.05	0.03	0.02	0.42	0.04	5.39	3.7	8.85	13.95	0.34	4.42	0.96	6.77
Kullu	0.8	0.9	0.66	0.31	0.97	0.85	2.84	2.21	1.98	2.09	0.74	1.61	1.96	2.13
L&S	0.00	0.02	0.00	0.00	0.55	0.03	9.33	5.14	2.31	3.06	1.02	14.35	0.06	0.82
Mandi	0.88	0.97	1.66	1.48	0.5	1.1	0.84	0.92	3.41	0.95	0.52	1.13	1.37	0.46
Shimla	0.69	0.38	0.52	0.19	0.91	0.33	1.9	1.67	2.3	3.67	0.57	2.31	5.54	7.28
Sirmaur	1.13	0.9	0.63	0.99	1.08	0.8	1.09	1.26	0.46	7.21	0.9	0.68	0.46	0.1
Solan	1.22	1.22	0.5	0.41	0.9	1.04	0.6	1.12	0.02	0.00	2.18	1.02	0.08	0
Una	1.3	1.32	0.37	0.32	0.96	1.24	0.01	0.00	0.00	0.00	2.38	0.1	0	0
Crops/ District	Other Fruits		Potato		Other Vegetable		Spices		Oilseed		Fodder		Other crops	
	1972-73	2010-11	1972-73	2010-11	1972-73	2010-11	1972-73	2010-11	1972-73	2010-11	1972-73	2010-11	1972-73	2010-11
Bilaspur	3.58	18.25	0.01	0.01	1.11	0.49	0.33	0.4	0.48	0.57	0.21	0.49	0.68	0.37
Chamba	0.9	1.27	0.44	0.78	0.64	0.37	0.25	0.18	1.69	2.74	0.01	0.07	0.26	0.94
Hamirpur	0.02	0.23	0.02	0.01	0.6	0.15	0.06	0.17	0.18	0.05	0.05	0.41	0.52	0.03
Kangra	0.73	4.56	0.54	0.41	0.05	0.12	0.1	0.1	2.46	1.51	1.84	0.92	1.45	1.01
Kinnaur	6.33	6.72	2.27	0.57	0.47	5.01	0.04	0.84	0.02	0.01	0.00	0.00	0.10	0.07
Kullu	0.12	3.77	1.36	1.26	0.79	1.49	0.55	1.89	0.44	0.69	0.02	0.05	0.00	0.00
L&S	0.00	0.67	8.73	13.11	0.66	0.68	0.00	0.00	0.25	0.49	0.00	0.00	2.54	1.93
Mandi	1.35	1.57	0.44	0.95	1.39	0.66	0.23	0.52	0.26	0.38	0.28	0.47	5.72	0.2
Shimla	0.00	1.01	3.35	2.06	21.24	2.8	0.49	0.83	0.06	0.24	0.01	0.07	0.03	0.00
Sirmaur	3.58	2.37	0.61	0.63	0.39	0.97	6.18	6.9	0.6	1.03	0.66	3.06	1.93	3.65
Solan	1.82	1.86	0.18	0.06	4.04	3.00	1.29	1.11	1.42	1.46	2.19	2.16	0.96	0.07
Una	0.51	1.55	0.09	0.55	1.2	0.24	0.01	0.07	0.46	1.59	3.75	3.28	1.98	0.25

CONCLUSION

The results of the study as discussed above suggest a declining trend over time in crop diversification in Himachal Pradesh. Farmers in the state are adjusting their cropping patterns to incorporate a higher mix of high value crops; particularly fruits and vegetables. As a result, the traditionally grown crops are getting replaced or ignored. This is expected because of the proven superiority of these crops towards raising farm incomes. However, a broader network of high value crops is required to safeguard farmers against different risks of specialization or near specialization. The diversification may include varietal diversification as well; varieties promoted by considering the agroclimatic conditions and other production and marketing environments. The area under fruits, vegetables and cardamom & spices had registered positive growth. In Shimla, Sirmaur, Kullu, and Kinnaur district more emphasis is on apple plantation. Similarly, emphasis on introduction of off-season vegetable crops in Kullu, Shimla, Solan, and Sirmaur has also resulted in decline in the area under food crops. The concentration of fruits and vegetables in Shimla, Kullu, Solan, Sirmaur, and Chamba district have created a kind of feeling that farmers in these districts may be shifting towards specialization. To encourage diversification suitable alternate cropping patterns, need to be promoted, that include a fair mix of high value crops to protect farmers against various kinds of risks. This requires working on a larger canvas to take note of dissemination of knowledge for production and marketing management of the produce for sustaining interest of the farmers and also for sustainable agriculture development in the state.

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