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Crop Diversification and Crop Specialization: A Case Study of Himachal Pradesh

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Abstract
Agriculture is a prime source of livelihood in almost every state of India and the state of Himachal Pradesh is among those where almost seventy percent population is directly or indirectly dependent on it. However agriculture in the state is obliged to different agro-climatic conditions. To overcome these obligations farmers in Himachal Pradesh have shifted towards crop diversification in early seventies. However there are tehsils in the state which have shown opposite trends, as in 1971 few tehsils of district Kangra and Bilaspur have shown crop specialization and recently in 2011 this trend of crop specialization has been reflected by few tehsils of district Shimla. These trends were and are the outcome of various hindrances farmers are facing in practicing crop diversification. Therefore the proposed research will analyse the overall situation of crop diversification and crop specialization in Himachal Pradesh and its corresponding factors between 1971 and 2011. For this proposed research secondary data has been used. To calculate crop specialization Gibb's-Martin Index has been used. The results of the index have highlighted that state as a whole is more focused on crop diversification rather than crop specialization. However crop specialization has also been found in few pockets of the state.

Keywords: Agriculture, Crop Diversification, Crop Specialization, Himachal Pradesh, Gibb's-Martin Index

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Introduction
Crop diversification has been regarded as a strategy of green agricultural as it has potential benefits of ecological and economic implications like risk management and cost saving (Lin 2011). Therefore to understand the importance of crop diversification and to boost farmers across world to adopt diversification various organizations of the world like World Band, Food and Agriculture Organization, Intergovernmental Panel on Climate Change etc. have increased financial and policy support for crop diversification (Makate et.al. 2016). Likewise, research efforts to understand the process and impacts of crop diversification in a better way on farm performance have also increased (Arslan et.al. 2018).

Crop diversification has been practiced by farmers to gain several benefits as it has the calibre to reduce income uncertainty, increase yield stability, lead to cost reduction in the presence of scope economies, increase incomes, bring about nutritional diversity and reduce the likelihood of being poor (Rahman, 2009). It has also been practised to provide more spatial and temporal biodiversity at the farm level, improve soil fertility as well as prevention from pests and diseases (Manjunatha, 2013).

On the other hand, crop diversification has few drawbacks as compared to specialization, including lower profitability and productivity (Pope and Prescott, 1980). As farmers allocate their resources across multiple crop enterprises, they may miss out on the economies of scale that come with specialization (Purdy et. al., 1997). In contrast, specialization allows farmers to focus on production practices that align with their comparative advantage, resulting in higher productivity and profitability (Falco and Chavas, 2009).

Crop specialization simply means dominance of single crop on a specific farm or in other words monoculture. This term can also be regarded as agricultural development which is based on market, as market provides increased specialization at the farm level with enhanced market participation (Timmer, 1997). Even in green revolution the main objective was to support this process with agricultural policies in developing countries for many decades (Evenson and Gollin, 2003). On the other hand one of the most important factors which determine the economic performance of the agricultural farm lies in the production lines, as it decides the specialization or diversification of the farm. It is important to highlight that the increase in production specialization leads to an increase in its profitability, which is related to the growing advantages of scale (Stepien, 2007). Simply crop specialization in agriculture means reducing the variety of diversity or increasing the production of few selected products which is accompanied by maintaining the production of remaining products at an unchanged level (Chylek, 2005). Achieving these targets is possible due to an increase in the intensity of the use of resources, which accompanies specialized production. This has resulted in the efficiency of production on the one hand and it has adversely affected the quality of agricultural production, space and the natural environment of the villages on the other hand (Wos and Zegar, 2002).

Therefore it is important to highlight that there are economic benefits resulting from diversification and specialization both however a question arises here that is there any correlation between the structure of agricultural production and the impact of agriculture on the quality of natural resources. Currently, the answer to this question is of particular significance, which ensures the growing importance of agriculture as a provider of public goods.

Hence the present research has been focused on both crop diversification and crop specialization and also on their corresponding factors in the state of Himachal Pradesh between 1971 and 2011.

Objectives

Following research objective has been proposed in the present research:

i. To analyse the patterns of crop diversification and crop specialization in Himachal Pradesh and its corresponding factors between 1971 and 2011.

Data Sources

In the present research secondary data has been used. Secondary data related to area under various crops (i.e. Food crops, vegetables and fruits) at tehsil level has been collected from various government departments which are located at Shimla. Like data related to food grains has been collected from Directorate of Land records, Kasumpati, data related to vegetables has been collected from Directorate of Agriculture, Krishi Bhawan and data related to fruits or horticultural crops has been collected from Directorate of Horticulture, Navbahar, Chotta Shimla.

Secondary data related to the base map of Himachal Pradesh for map making and names of tehsils has been collected from Census of India.

Data collected form secondary sources has been presented through tables and maps for better understanding.

Methodology

To calculate crop diversification Gibb's Martin index has been used by applying the following formula:

$$GMI = 1 - \frac{\sum x^2}{(\sum x)^2}$$

Where

x = percentage of total cropped area under any individual crop

The index value of this method ranges between 0.10 to 0.90. Where 0.10 means the low diversification or crop specialization and 0.90 means high diversification .i.e. higher the value of index higher will be the degree of diversification and vice- versa.

After calculating the index for all the tehsils for 1971 and 2011 tehsils will be divided in the following groups according to their diversification index value

1) Tehsils with high diversification (Index value more than 0.70)
2) Tehsils with moderate diversification (Index value between 0.40 to 0.70)
3) Tehsils with low diversification (Index value less than 0.40)

Where

High Diversification means that the farms are used extensively with number of crops. Which also means that in one cropping season farmers are growing food grains like rice, maize, wheat, pulses etc. with fruits and vegetables also. In this category of diversification farmers are giving equal importance all the crops like putting 30 to 35 percent area under food grains and almost same under fruits and vegetables. The farmers in high diversification tehsils are mainly focused on variety of crops. These tehsils are the main reason behind off season vegetables production.

Moderate Diversification in the present study means that the farmers are growing number of crops in their fields but by giving major part of the area to one or two crops. Like they are growing cereals, pulses, fruits and vegetables all, but instead of giving equal proportion to every crop they are growing one money generating or profit generating crop on large area than other crops. Like in vegetables farmers are growing tomato, peas, cauliflower, beans, capsicum etc. as major crops and cabbage, ladyfinger, potato etc. as minor crops. In food grains rice and wheat as major crops and maize, barley, pulses as minor crops and in fruits apple, orange, mango as major crops and other fruits as minor crops. This type of division maintains balance of their income as well as the balance of the soil health. The main reason behind this specific combination is that these crops are more profit generating than their accompanying crops.

Low Diversification or Crop Specialization index range specifically shows the dominance of one single crop. The level of diversification is correspondent to the harsh climatic and topographical conditions, where farmers are mainly focused on single income generating crop like apple. These apple growing locations are mostly covered with snow which makes it difficult to do agriculture throughout the year. Therefore farmers in these locations have adopted single money generating crop system in these areas.

This single crop system or crop specialization also means that the climate and topography of that specific area is not suitable for the agriculture. And in some parts it also means the growth of industrialization or secondary activities like district Solan.

Results and Discussions

Agriculture is the main source of livelihood in most parts of the world; however it's been practiced differently all over the globe according to availability of resources. The main focus of the farmers around the globe is to maximise their productions and profits. To achieve their goals farmers practice both crop diversification and crops specialization as well. However the practice of crop diversification is on large number in comparison to crop specialization.

Mostly crop specialization is the output of major hindrances farmers face in practising crop diversification. However the main reasons behind the practice of crop diversification are better infrastructure, demand, fertile soil, availability of labour, government schemes, profits, production etc.

Practice of crop diversification and crop specialization are different in every part of the world and in India itself. Like in Himachal Pradesh crop diversification has been practiced since the formation of the state in the early seventies i.e. 1971. In 1971 there were sixty tehsils in the state which have reflected high diversification patterns, fifty one tehsils have shown moderate patterns, however crop specialization has been found in very small pockets of the state in 1971 i.e. in two tehsils of Bilaspur district and four tehsils of Kangra district (Table 1.1,1.2,1,3).

Table 1.1
Himachal Pradesh: Crop Diversification Index (GMI), 1971

Serial Number	Tehsils with High Diversification (>0.70)	Index Value	Serial Number	Tehsils with High Diversification (>0.70)	Index Value
1	Manali	0.83	31	Nahan	0.77
2	Kotkhai	0.83	32	Padhar	0.77
3	Kullu	0.83	33	Palampur	0.77
4	Cheta	0.82	34	Theog	0.77
5	Chaupal	0.82	35	Thural	0.77
6	Kumharsain	0.82	36	Udaipur	0.77
7	Nankhari	0.82	37	Kamrau	0.76
8	Nerua	0.82	38	Nermand	0.76
9	Rampur	0.82	39	Pachhad	0.76
10	Ani	0.81	40	Paonta Sahib	0.76
11	Bali Chowki	0.80	41	Rajgarh	0.76
12	Chachyot	0.80	42	Chirgaon	0.74
13	Nalagarh	0.80	43	Dadahu	0.74
14	Ramshahr	0.80	44	Dodra Kwar	0.74
15	Thunag	0.80	45	Kasauli	0.74
16	Baddi	0.79	46	Nohra	0.74
17	Brahmaur	0.79	47	Renuka	0.74
18	Holi	0.79	48	Rohru	0.74
19	Jubbal	0.79	49	Ronhat	0.74
20	Banjar	0.78	50	Shalai	0.74
21	Sainj	0.78	51	Solan	0.74
22	Baijnath	0.77	52	Tikar	0.74

23	Dhira	0.77	53	Aut	0.73
24	Jaisinghpur	0.77	54	Mandi	0.73
25	Jogindarnagar	0.77	55	Morang	0.73
26	Kandaghat	0.77	56	Poo	0.73
27	Krishangarh	0.77	57	Kalpa	0.72
28	Lad Bharol	0.77	58	Nihri	0.72
29	Lahaul	0.77	59	Sundarnagar	0.72
30	Multhan	0.77	60	Pangi	0.71
State Average: 0.73					

Source: Directorate of Land Records, Shimla, Himachal Pradesh, 1971 (Calculated using Gibb's-Martin Index)

High and moderate diversification in this time period has been a result of various factors like the first three five year plans of the state were devoted towards the development of infrastructure like roads and development of agriculture as well. On the other hand green revolution has also given boost to the production and cultivation of various food grain crops. In some parts of the state introduction of apple crop has also gave boost to the diversification of fruits. Whereas crop specialization is the outcome of numerous factors like uneven terrain, climate change, lack of availability of labour, small size of landholdings, problems in using modern machineries, low productions, higher profit margins from single crops.

Table 1.2
Himachal Pradesh: Crop Diversification Index (GMI), 1971

Serial Number	Tehsils with Moderate Diversification (0.70-0.40)	Index Value	Serial Number	Tehsils with Moderate Diversification (0.70-0.40)	Index Value
1	Arki	0.69	27	Amb	0.61
2	Baldwara	0.69	28	Bangana	0.61
3	Bhadrota	0.69	29	Bharwain	0.61
4	Chamba	0.69	30	Haroli	0.61
5	Darlaghat	0.69	31	Karsog	0.61
6	Dharampur	0.69	32	Naina Devi	0.61
7	Kotli	0.69	33	Una	0.61
8	Nichar	0.69	34	Junga	0.59
9	Sandhol	0.69	35	Shimla (Rural)	0.59
10	Sarkaghat	0.69	36	Shimla (Urban)	0.59
11	Sihunta	0.69	37	Fatehpur	0.56
12	Barsar	0.68	38	Jawali	0.56
13	Bhalai	0.68	39	Indora	0.56
14	Bhoranj	0.68	40	Nurpur	0.56
15	Chaurah	0.68	41	Baroh	0.55
16	Dhatwal	0.68	42	Dharmshala	0.55
17	Glore	0.68	43	Harchakian	0.55
18	Hamirpur	0.68	44	Kangra	0.55
19	Nadaun	0.68	45	Khundian	0.55
20	Saluni	0.68	46	Nagrota Bagwan	0.55
21	Tira Sujanpur	0.68	47	Shahpur	0.55
22	Bhattiyat	0.67	48	Seoni	0.52
23	Dalhousie	0.67	49	Spiti	0.52

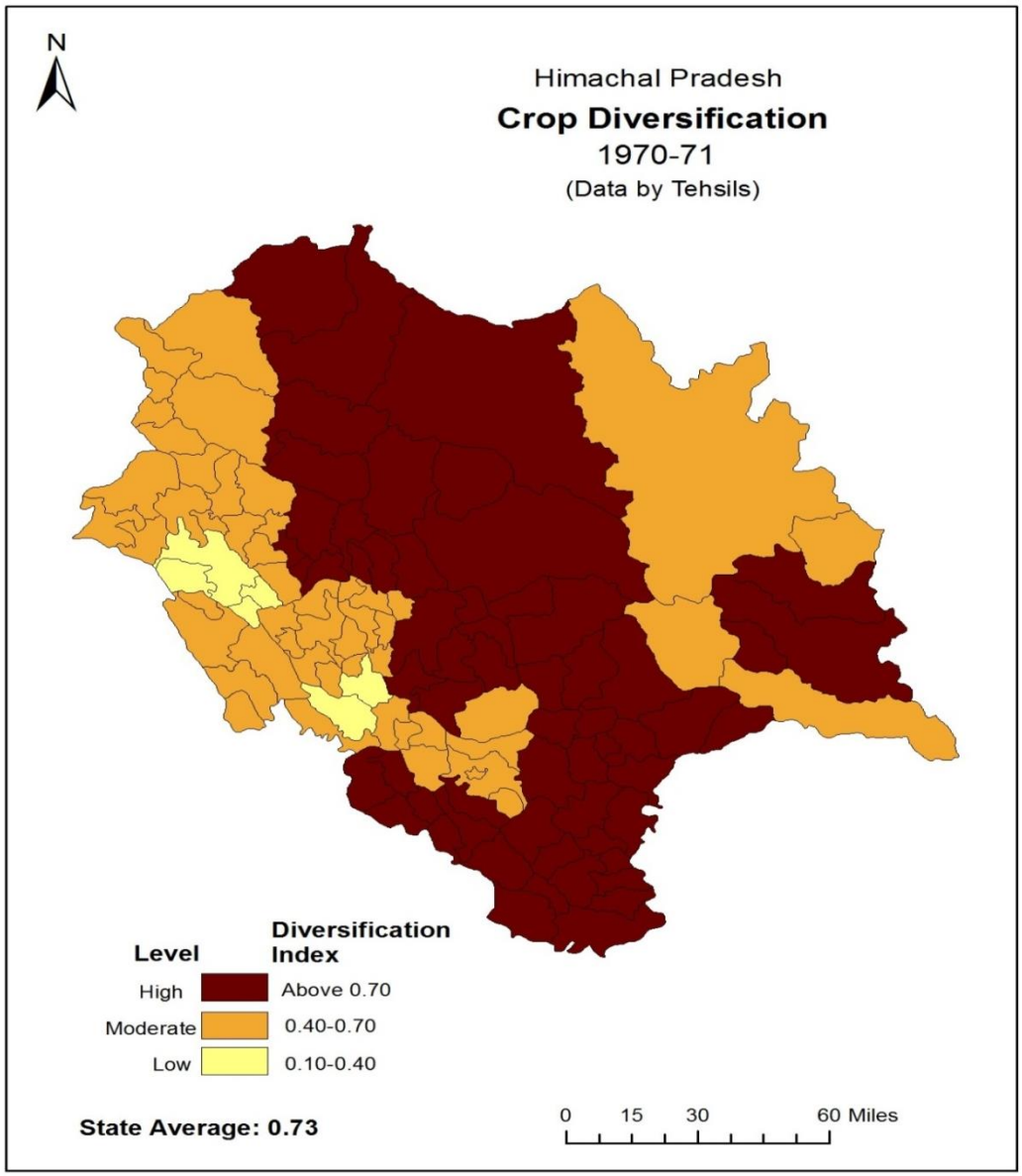
24	Hangrang	0.67	50	Sangla	0.46
25	Bilaspur Sadar	0.62	51	Bharari	0.40
26	Namloh	0.62			
State Average: 0.73					

Source: Directorate of Land Records, Shimla, Himachal Pradesh, 1971 (Calculated using Gibb's-Martin Index)

These patterns of crop diversification and crop specialization have changed in the span of forty years i.e. between 1971 and 2011. As in 2011 forty eight tehsils practised high crop diversification, sixty six have practiced moderate diversification and only three tehsils have shown low crop diversification patterns (or crop specialization) (Table 1.4, 1.5 and 1.6).

Moderate crop diversification (i.e. crop diversification but with dominance of one or two crops) and low diversification (or crop specialization) in the state in 2011 is the major outcome of WTO reforms of 1995. These reforms have provided farmers with open markets, globalization and many other benefits which have shifted farmers' interest in cultivating single crop rather than more number of crops (Devi, 2020).

Map: 1.1



Source: Directorate of Land Records, Shimla, Himachal Pradesh, 1970-71

Table 1.3
Himachal Pradesh: Crop Diversification Index (GMI), 1971

Serial Number	Tehsils with Low Diversification (0.40-0.10)	Index Value
1	Jhanduta	0.37
2	Ghumarwin	0.35
3	Dera Gopipur	0.25
4	Jaswan	0.25
5	Jawalamukhi	0.25
6	Rakkar	0.25
State Average: 0.73		

Source: Directorate of Land Records, Shimla, Himachal Pradesh, 1971 (Calculated using Gibb's-Martin Index)

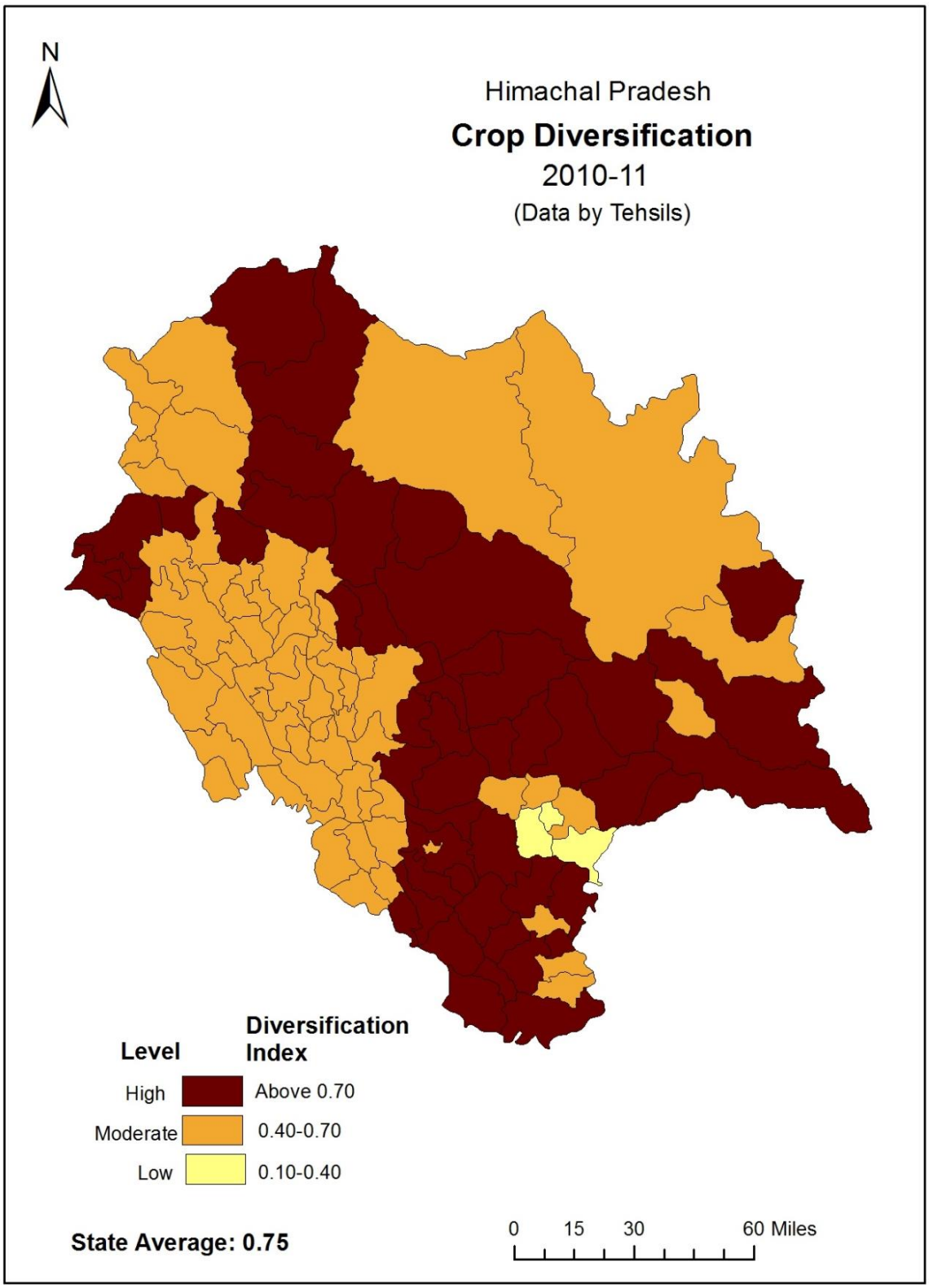
In 2011 only three tehsils of district Shimla have shown crop specialization as these tehsils falls in the major apple producing belt of the state. The three tehsils are Tikar, Jubbal and Kotkhai. On the other hand crop specialization in these tehsils is the outcome of factors like snow covered roads in most time of the years, unavailability of labour, more income from single crop, terrain not suitable for cultivation of vegetables and food grains, untimely rainfall, landslides along the national highways and link roads as well.

Table 1.4
Himachal Pradesh: Crop Diversification Index (GMI), 2011

Serial Number	Tehsils with High Diversification (>0.70)	Index Value	Serial Number	Tehsils with High Diversification (>0.70)	Index Value
1	Rajgarh	0.90	25	Nichar	0.76
2	Junga	0.87	26	Pangi	0.76
3	Nohra	0.87	27	Renuka	0.76
4	Holi	0.86	28	Karsog	0.75
5	Cheta	0.85	29	Shimla (Rural)	0.75
6	Nerua	0.85	30	Udaipur	0.75
7	Thunag	0.85	31	Aut	0.74
8	Kandaghat	0.84	32	Morang	0.74
9	Rampur	0.84	33	Nihri	0.74
10	Brahmaur	0.83	34	Paonta Sahib	0.74
11	Manali	0.83	35	Chachyot	0.73
12	Solan	0.83	36	Nurpur	0.73
13	Kullu	0.82	37	Fatehpur	0.72
14	Multhan	0.82	38	Jogindarnagar	0.72
15	Pachhad	0.82	39	Nahan	0.72
16	Banjar	0.81	40	Padhar	0.72
17	Ani	0.80	41	Ronhat	0.72
18	Sangla	0.79	42	Sainj	0.72
19	Dodra Kwar	0.78	43	Seoni	0.72
20	Indora	0.78	44	Dadahu	0.71
21	Nermand	0.78	45	Sihunta	0.71
22	Chirgaon	0.77	46	Dharmshala	0.70
23	Theog	0.77	47	Hangrang	0.70
24	Bali Chowki	0.76	48	Kasauli	0.70
State Average: 0.75					

Source: Directorate of Land Records, Shimla, Himachal Pradesh, 2011 (Calculated using Gibb's-Martin Index)

Map: 1.2



Source: Directorate of Land Records, Shimla, Himachal Pradesh, 2010-11

Table 1.5
Himachal Pradesh: Crop Diversification Index (GMI), 2011

Serial Number	Tehsils with Moderate Diversification (0.70-0.40)	Index Value	Serial Number	Tehsils with Moderate Diversification (0.70-0.40)	Index Value
1	Baijnath	0.69	34	Una	0.63
2	Chaupal	0.69	35	Baroh	0.62
3	Dalhousie	0.69	36	Thural	0.62
4	Krishangarh	0.69	37	Jaisinghpur	0.61
5	Lad Bharol	0.69	38	Kotli	0.61
6	Bhattiyat	0.68	39	Lahaul	0.61
7	Palampur	0.68	40	Spiti	0.61
8	Bhalai	0.67	41	Khundian	0.60
9	Chamba	0.67	42	Amb	0.59
10	Kangra	0.67	43	Sandhol	0.59
11	Nagrota Bagwan	0.67	44	Bharari	0.58
12	Chaurah	0.66	45	Bhoranj	0.58
13	Harchakian	0.66	46	Jaswan	0.58
14	Haroli	0.66	47	Dera Gopipur	0.57
15	Jawali	0.66	48	Jawalamukhi	0.57
16	Kalpa	0.66	49	Bharwain	0.56
17	Saluni	0.66	50	Ghumarwin	0.56
18	Shahpur	0.66	51	Naina Devi	0.56
19	Baddi	0.65	52	Bangana	0.55
20	Dharampur	0.65	53	Jhanduta	0.55
21	Dhira	0.65	54	Hamirpur	0.54
22	Kumharsain	0.65	55	Bilaspur Sadar	0.53
23	Sundarnagar	0.65	56	Glore	0.53
24	Ramshahr	0.65	57	Barsar	0.52
25	Baldwara	0.64	58	Dhatwal	0.52
26	Bhadrota	0.63	59	Nadaun	0.52
27	Kamrau	0.63	60	Rakkar	0.52
28	Mandi	0.63	61	Tira Sujanpur	0.52
29	Nalagarh	0.63	62	Nankhari	0.48
30	Namloh	0.63	63	Shimla (Urban)	0.45
31	Poo	0.63	64	Rohru	0.43
32	Sarkaghat	0.63	65	Arki	0.41
33	Shalai	0.63	66	Darlaghat	0.41
State Average : 0.75					

Source: Directorate of Land Records, Shimla, Himachal Pradesh, 2011 (Calculated using Gibb's-Martin Index)

However crop diversification is the result of other corresponding factors of diversification like formation of major research institutes which are solely devoted to agriculture development like IARI (Indian Agricultural Research Institute) Kullu, CPRI (Central Potato Research Institute) Shimla, Mushroom Research Centre Solan etc., along with these institutes establishment of agriculture university in Palampur and Nauni have also helped in training farmers and students in the field of agriculture, introduction of vegetables, proximity ot markets like Chandigarh, Delhi, Punjab, Haryana etc.

Crop specialization which is found only in three tehsils namely Tikar, Jubbal and Kotkhai belongs to district Shimla (Map 1.2). Earlier in late sixties and early seventies, when crop diversification was introduced in the state with apple, thereafter state's agriculture shifted towards vegetables in late eighties and early nineties.

Table 1.6
Himachal Pradesh: Crop Diversification Index (GMI), 2011

Serial Number	Tehsils with Low Diversification (0.40 to 0.10)	Index Value
1	Tikar	0.37
2	Jubbal	0.16
3	Kotkhai	0.14
State Average: 0.75		

Source: Directorate of Land Records, Shimla, Himachal Pradesh, 1971 (Calculated using Gibb's-Martin Index)

From Table 1.4 and 1.5 it is evident that district Shimla and most of its corresponding tehsils have shown high to moderate diversification in 2011. However these three tehsils have shown crop specialization (Table 1.6). Despite various favouring factors for crop diversification farmers in these tehsils are practising crop specialization due to more prominent factors for crop specialization such as marginal land holdings, changing climate, poor transportation facilities etc.

Conclusion

To conclude it can be said that between 1971 and 2011 farmers in the state had to confront many physical constraints to continue their agricultural activities. To overcome these physical constraints farmers have practiced crop diversification and crop specialization according to their available resources. The results of the index indicates that the farmers in the state adopted crop diversification in high spirits at the initial stage .i.e. 1971, however changed food demands along with many other factors like changed climate, decreased land holdings size, increased population etc. changed the patterns of crop diversification in the four decades. Between 1971 and 2011 the crop diversification value of state increased from 0.73 to 0.75. However at tehsil level 62 tehsils changed negatively, 52 tehsils positively and 3 tehsils have shown no change in their crop diversification value.

In 1971 high crop diversification was experienced by maximum tehsils. However it changed to moderate due to factors like agro-climatic conditions, changed food demands, migration of youth to other states, government schemes, technological advancements, dependency on labour etc.

However the patterns of crop specialization have been found in very small pockets of the state. Initially these patterns have been reflected by the districts of Bilaspur and Kangra, which have later shifted to district Shimla. These patterns have been the results of various factors which favours crop specialization like snow covered roads in most time of the years, unavailability of labour, more income from single crop, terrain not suitable for cultivation of vegetables and food grains, untimely rainfall, landslides along the national highways and link roads as well

Undoubtedly most of the tehsils in the state falls under the high and moderate diversification category, however the fact that the value of crop diversification index of maximum tehsils have changed negatively cannot be ignored. As it can have adverse effects on the agriculture and diversification process of the state. If this change will go unnoticed it can lead to severe problems like shortage of food grains, monopoly of few crops, degradation of soil fertility, change in overall crop productions etc.

Therefore it is important to control the changing patterns of crop diversification in the state by helping farmers to understand the actual problems they have to face in near future because of cultivation of few crops. The major role can be played by the state government by addressing the actual problems farmers are facing in practicing crop diversification.

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