



CROP DIVERSIFICATION REGIONS: 1980-81 TO 2000-01

Dr. Pooja Rana

P.G. Department of Geography

Lyallpur Khalsa College, Jalandhar

Abstract

Crop diversification is the product of action, reaction and interaction among physical and non-physical environments. It also highlights spatial variations in farming system prevalent among farmers within physical possibilities of agricultural relevance. It is right to say that greater the diversification, greater is the competition among crops which can be raised under prevailing physical environment, But it is also equally right that the farmers have learnt through experience that the cultivation of a variety of crops ensure economic returns of at least from few crops in areas of having high variability of rainfall. Thus, the feeling for some assure returns from at least some crops is natural among the poor farmers which are having small size of land holdings. With poor agricultural infrastructure in the tradition bound system, farmers grow cereal and non-cereal crops to meet their domestic requirement which generally leads to high degree of crop diversification. Moreover, small and marginal farmers also raise a number of crops for replenishing the soil fertility. Because it is an established fact that monoculture if practiced for a number of years leads to soil depletion. Crop diversification also generates more employment for the small farmers as well as for agricultural labourers throughout the year by growing different crops. While crop specialisation means low competition among growing crops which shows that either the physical environment doesn't permit crop diversification or the farmers, because of their better economic conditions are interested only in few crops which fetch higher economic returns to them. Thus it is recognized that a study of spatial patterns of crop diversification is of vital importance and almost indispensable to understand the competition that goes on among different crops.

Introduction

The concept of crop-diversification means competition among various grown crops for space in a given region. It is an indicator of multiplication of crops which obviously involves intensive competition among the growing crops. Keener the competition the higher the magnitude of crop diversification and lesser the competition greater will be the trend towards specialisation or monoculture farming where emphasis is on one or two crops (Singh and Dhillon, 2004). The magnitude of crop diversification shows that whether the cropping pattern is towards crop specialisation or towards crop diversification. It is a concept which is opposite to crop specialisation. Crop diversification mirrors the impact of physical, social, economic and technological influences on cropping pattern. It means the crop diversification is the product of action, reaction and interaction among physical and non-physical environments. It also highlights spatial variations in farming system prevalent among farmers within physical possibilities of agricultural relevance. It is right to say that greater the diversification, greater is the competition among crops which can be raised under prevailing physical environment, But it is also equally right that the farmers have learnt through experience that the cultivation of a

variety of crops ensure economic returns of at least from few crops in areas of having high variability of rainfall. Thus, the feeling for some assure returns from at least some crops is natural among the poor farmers which are having small size of land holdings. With poor agricultural infrastructure in the tradition bound system, farmers grow cereal and non-cereal crops to meet their domestic requirement which generally leads to high degree of crop diversification. Moreover, small and marginal farmers also raise a number of crops for replenishing the soil fertility. Because it is an established fact that monoculture if practiced for a number of years leads to soil depletion. Thus it is recognized that a study of spatial patterns of crop diversification is of vital importance and almost indispensable to understand the competition that goes on among different crops.

Several scholars from geography, economics and allied disciplines have made several attempts to study crop diversification in different parts of the world. Among them, prominent are Bhatia, Ayyar, Gibbs and Martin, Singh, etc. Singh (1976) developed a simple formula to calculate the degree of diversification. With this method, the index of crop diversification is obtained by summing up the harvested area of those crops which are having 5.0 per cent or more area to the total harvested area. He then divided the sum by the number of N crops. Thus, he observed that lower the index, higher is the magnitude of crop diversification and vice-versa. The formula is:

$$\text{Index of Crop Diversification} = \frac{\text{Percent of Total Harvested Area under 'N' Crops}}{\text{Number of 'N' Crops}}$$

Where: 'N' crops are those crops which individually occupy 5 per cent or more of the total harvested area in a regional unit.

$$\text{Index of Crop Diversification} = \frac{\text{Percent of Total Harvested Area under 'N' Crops}}{\text{Number of 'N' Crops}}$$

In 1969, Ayyar modified Bhatia's method and took into account only those crops which individually occupy at least 1 per cent or more of the total cropped area. He also found that lower the index, higher is the magnitude of crop diversification and vice-versa. His formula is:

$$\text{Index of Crop Diversification} = \frac{\text{Percent of Total Cropped Area under 'x' Crops}}{\text{Number of 'x' Crops}}$$

Where: 'x' crops are those which occupy at least 1 per cent or more of the total cropped area.

The Gibbs and Martin (1962) gave the formula for calculation the index of crop diversification. Their index of crop diversification is useful index for measuring the magnitude of degree of crop diversification. Their formula is as follow:

$$\text{Index of Crop Diversification} = 1 - \frac{\sum x^2}{(\sum x)^2}$$

Where 'X' is the percentage of total cropped area occupies by an individual crop. According to this method the index of crop diversification varies between 0.0 to 0.9. This method considers the number factor and even factor. Besides, the indices are directly related to the magnitude of diversification. Here higher the index, higher is the diversification and vice-versa (Gibbs and Martin, 1962). However in Singh, Bhatia and Ayyar's methods, the index of diversification is inversely related to diversification i.e. lower the index, higher is the magnitude of crop diversification and higher the index, lower the magnitude of the crop diversification. The index of crop diversification provides a method of generalizing the relationship between the relative strength and number of crops grown in a region (Bhatia, 1965). The regional dominance of some crops in an area also has some relationship with other crops, indicating a strong bearing on the degree of crop diversification or specialisation.

In the study region, for calculating the crop diversification index, three methods namely Gibbs and Martin's, Singh's and Ayyar's have been applied. For making an in depth analysis of patterns of crop diversification and changes therein, the present chapter is divided into four sub-chapters. These are:

- A. Patterns of crop diversification: 1980-81
- B. Patterns of crop diversification: 2000-01

A. Patterns of Crop Diversification, 1980-81

To find out the degree of crop diversification in Bari-Doab region of Punjab, three methods namely Gibbs and Martin, Singh and Ayyar were taken into account. The results obtained from these methods are mapped individually which are discussed in detail in this part of the chapter. These are as follow.

I. Spatial Distribution of Crop Diversification after Gibbs and Martin. (1980-81)

The index value of overall crop diversification of the study region was 0.71 in 1980-81. It varied between 0.63 in Saidpur village of Baba Bakala tehsil to 0.80 in Rohg village of Dhar Kalan tehsil. To know these variations in crop diversification the study region was divided into three categories which were discussed in fig. 6.1 and table 6.1.

Table 6.1

Patterns of Crop Diversification, (1980-81)
(After Gibbs and Martin)

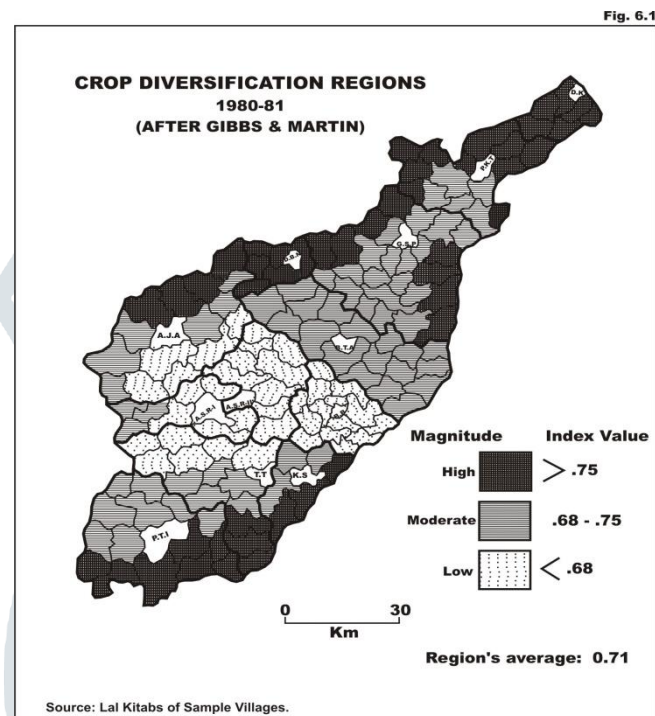
Category	Index Value	Frequencies
High	> 0.75	46
Moderate	0.68-0.75	85
Low	< 0.68	39

Source: Lal Kitabs of Sample Villages.

1. Areas of high crop diversification (>0.75): High crop diversification was found in Dhar Kalan and Dera Baba Nanak tehsils, north-western parts and a small patch in eastern parts of Pathankot tehsil, eastern and western stretches of Gurdaspur tehsil, western stretch of Ajnala tehsil, eastern stretch of Khadoor Sahib tehsil, eastern part of Tarn Taran tehsil, and south-eastern stretch of Patti tehsil. In these areas, rugged topography and

lack of adequate irrigation facilities in Dhar Kalan and Pathankot tehsils, less developed irrigation problem of water-logging, poor soils, etc. were the main reasons of high crop diversification.

2. Areas of moderate crop diversification (0.68 to 0.75): Moderate crop diversification was recorded in the southern parts of Pathankot tehsil, central areas of Gurdaspur tehsil, Batala tehsil, western parts of Khadoor Sahib tehsil, some patches in central and western parts of Ajnala tehsil, southern tip of Amritsar-I tehsil, central parts of Tarn Taran tehsil and Patti tehsil except its south-eastern stretch. In these areas, cultivation of selected crops and less developed irrigation, etc. had compelled the farmers to grow those crops which fetch higher economic returns and all this led to moderate magnitude of crop diversification.



3. Areas of low crop diversification (<0.68): Category of low crop diversification was found in Amritsar-II tehsil, Baba Bakala tehsil, Amritsar-I tehsil except its southern tip, eastern parts of Ajnala tehsil and northern parts of Tarn Taran tehsil. These areas had fertile soils, flat land, developed network of irrigation, easy access to markets and developed agricultural infrastructure. All this had enthused the farmers to grow only those few crops which fetch higher economic return rather than going for plenty of crops. Thus due to all these reasons magnitude of crop diversification was recorded low in these areas.

II. Spatial Distribution of Crop Diversification after Singh, (1980-81)

The index value of overall crop diversification in the study region was 26.2 in 1980-81 which varied from 17.3 in Margindpura village of Patti tehsil to 32.6 in Verka village of Amritsar-II tehsil. To know these variations, the study region was grouped into following categories and was shown in fig. 6.2 and table 6.2. These are:

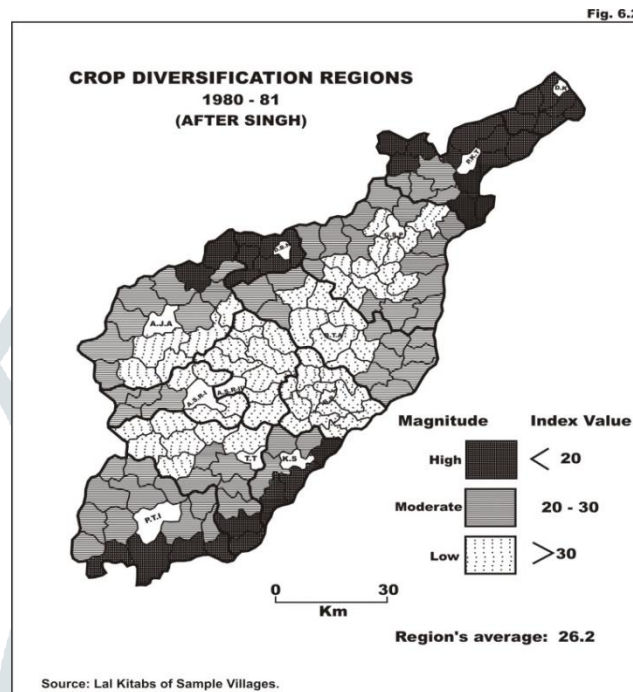
Table 6.2

Patterns of Crop Diversification, (1980-81)

(After Singh)

Category	Index Value	Frequencies
High	< 20	32
Moderate	20-30	61
Low	> 30	57

Source: Lal Kitabs of Sample Villages.



1. Category of high crop diversification (<20): This category was recorded in Dera Baba Nanak tehsil, Dhar Kalan tehsil, north-western and some eastern parts of Pathankot tehsil, few small patches in western part of Ajnala tehsil, eastern stretches of Khadoor Sahib tehsil, eastern stretches of Tarn Taran tehsil, and south-eastern stretch of Patti tehsil. In case of Dhar Kalan and Pathankot tehsils, harsh physical environment which comprised of dissected topography, undulating plains, soil erosion, inadequate and deep aquifers of sub-soil water, etc. were identified as the main reasons for high magnitude of crop diversification, while rest of the area of this category were water-logging *bet* areas. Thus farmers had grown number of crops in these areas mainly for domestic consumption and very little part of it was being marketed. Thus, agriculture in these areas was highly diversified and subsistence in nature.

2. Category of moderate crop diversification (20-30): Areas of moderate crop diversification was recorded in the southern parts of Pathankot tehsil, Gurdaspur tehsil except its central parts, eastern and western parts of Batala tehsil, some central and western parts of Ajnala tehsil, southern parts of Amritsar-I tehsil, western parts of Khadoor Sahib tehsil, central parts of Tarn Taran tehsil and Patti tehsil except its south-eastern stretch. In these areas, comparatively less developed irrigation, poor soils, low population pressure, etc. had led the farmers to grow comparatively few crops by restricting their choice. And as a result this category had moderate degree of crop diversification.

3. Category of low crop diversification (>30): Low crop diversification category has contained 57 frequencies. It was recorded in the central areas of the study region comprising the central parts of Gurdaspur,

Batala, Amritsar-II and Baba Bakala tehsils, northern part of Amritsar-I tehsil, eastern stretch of Ajnala tehsil and the northern parts of Tarn Taran tehsil. These areas were most suitable for crop farming which were gifted with fertile soils, flat land and excellent network of irrigation, developed agricultural infrastructure and diffusion of green revolution technology, etc. As a result all these areas had low degree of crop diversification.

III. Spatial Distribution of Crop Diversification after Ayyar (1980-81)

The index value of overall crop diversification for the study region was recorded 17.1 which ranged from 11.1 in Budhe Bela village of Gurdaspur tehsil to 32.6 in Tung Piana village of Amritsar-I tehsil. To know these variations, these were grouped into following three categories and were shown in fig. 6.3 and table.6.3. Fig. 6.3 depicts three categories which are discussed below

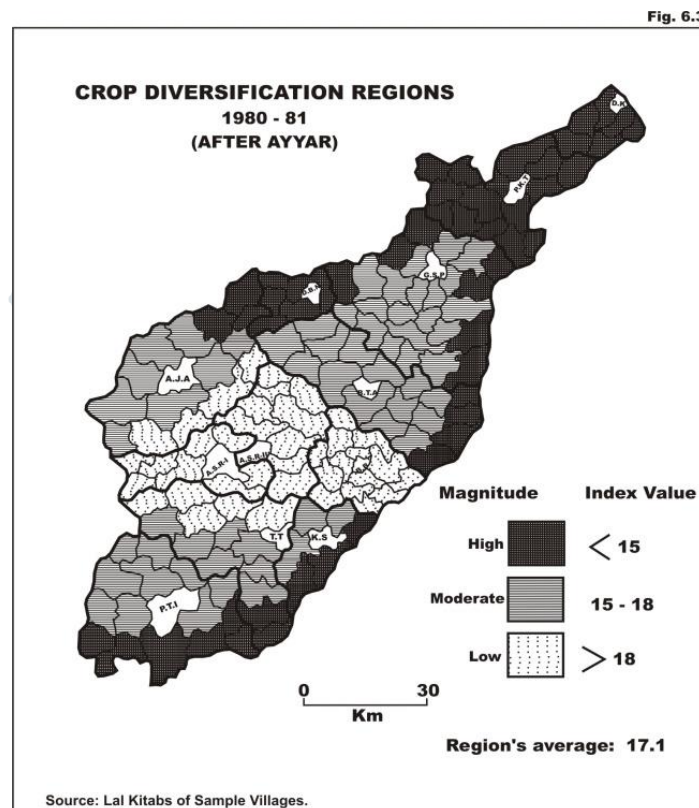


Table 6.3

Pattern of Crop Diversification, (1980-81)

(After Ayyar)

Category	Index Value	Frequencies
High	< 15	51
Moderate	15-18	49
Low	> 18	40

Source: Lal Kitabs of Sample Villages.

1. Areas of high crop diversification (<15): Magnitude of crop diversification had covered 51 frequencies which comprised the Dhar Kalan and Pathankot tehsils, eastern and western parts of Gurdaspur tehsil, eastern parts of Batala tehsil, Dera Baba Nanak tehsil, northern tip of Ajnala tehsil, eastern stretch of Khadoor Sahib tehsil, eastern part of Tarn Taran tehsil and south-eastern stretch of Patti tehsil. These areas were suffering from physical constraints. Northern part had harsh physical environment while rest of the areas were water-logged with poor soils and less developed irrigation. Thus all these factors had led to high degree of crop diversification in this category.

2. Areas of moderate crop diversification (15-18): Moderate magnitude of crop diversification had contained 49 frequencies and was recorded in the central parts of Gurdaspur tehsil, Batala tehsil except its eastern stretch, central and south-western parts of Ajnala tehsil, western parts of Khadoor Sahib tehsil, central parts of Tarn Taran tehsil and Patti tehsil except its south-eastern stretch. In these areas, less developed irrigation, lack of agricultural infrastructure, small size of land holdings, etc. were the main reasons for moderate degree of crop diversification.

3. Areas of low crop diversification (>18): This category of low magnitude of crop diversification had 40 frequencies and was found in Amritsar-I, Amritsar-II and Baba Bakala tehsils, eastern stretch of Ajnala tehsil, and the northern part of Tarn Taran tehsil. These areas had fertile soils, developed irrigation, excellent agricultural infrastructure, etc. Thus, these factors had made the farmers choosy to grow few crops which fetch higher and assured economic returns to them. So, all these factors had led to low magnitude of crop diversification in these areas.

Conclusion

For deriving the crop diversification regions of the study area, three techniques were applied namely Gibbs and Martin (1962), Singh, (1976) and Ayyar (1969). On the basis of Gibbs and Martin technique, the average index value of crop diversification for the study region was found 0.71 while it varied between 0.63 in Saidpur village of Baba Bakala tehsil to 0.80 in Rohg village of Dhar Kalan tehsil. On the basis of these index values, the study region was grouped into three categories: Areas of high crop diversification (over 0.75) which had got 46 frequencies. Areas of moderate crop diversification (0.68 to 0.78) with 85 frequencies, and areas of low crop diversification

(less than 0.68) which had 39 frequencies. Thus, it is observed that according to Gibbs and Martin's formula, about 50 per cent of the total frequencies had fallen in moderate category of crop diversification. In respect of Singh's technique the overall index of crop diversification for the study region was recorded 26.2, but it varied between 17.3 in Margindpura village of Patti tehsil to 32.6 in Verka village of Amritsar-II tehsil. The whole study area is grouped into three categories. These are: High category of crop diversification (<20) which covered 32 frequencies. The category of moderate crop diversification (20-30) which had 61 frequencies. While the category of low crop diversification (over 30) was found in 57 sample villages. According to Singh's index value of crop diversification, there were only 32 sample villages where the magnitude of crop diversification was recorded high. While in the remaining areas, it varied between low to moderate. The Ayyar's technique had given an index value of 17.1 for the study region. It varied between 11.1 in Budhebela village of Gurdaspur tehsil to 32.6 per cent in Tunj Piana village of Amritsar-I tehsil. On the basis of index values after Ayyar's technique, the Bari-Doab region was divided into three categories i.e. the areas of high crop diversification (<15) which had comprised 51 frequencies and were lying mostly in the tehsils of Dhar Kalan, and Pathankot and along the river courses of Ravi and Beas. While areas of moderate crop diversification (15-18) covered 49 frequencies which were lying in central parts of Gurdaspur, Batala, Ajnala, Patti, Tarn Taran and Khadoor Sahib tehsils. Whereas the areas of low crop diversification (>18) had 40 frequencies which were mainly found in the tehsils of Baba Bakala, Amritsar-I, Amritsar-II and some adjoining areas of Ajnala and Tarn Taran tehsils.

B. Patterns of Crop Diversification, 2000-01

The cropping pattern of Bari-Doab region in 2000-01 shows that several crops are grown namely wheat, rice, fodder, sugarcane, maize, oilseeds, pulses, vegetables, etc. To know the degree of competition among these crops, following methods have been applied for calculating the index of crop diversification. These methods of crop diversification are Gibbs and Martin's, Singh's and Ayyar's.

I. Patterns of crop diversification after Gibbs and Martin, (2000-01)

The index of crop diversification in the study region has not been uniformed. Striking variations have been marked during the study period. The index value of overall pattern of crop diversification in the study region is 0.67. It ranges from 0.57 in Sidhwan village of Baba Bakala tehsil to 0.79 in Rohg village of Dhar Kalan tehsil. To know the variations in crop diversification the Bari-Doab Region is grouped into the following categories which are shown in fig. 6.4 and table 6.4

1. Areas of high crop diversification ($>.70$): High crop diversification is found in

Dhar Kalan, Pathankot, Dera Baba Nanak tehsils, some patches in eastern and western parts of Gurdaspur tehsil, few patches in eastern parts of Batala tehsil, eastern parts of Khadoor Sahib tehsil, and a small patch in Tarn Taran tehsil and south-eastern parts of Patti tehsil. Reasons being in Dhar Kalan and Pathankot tehsils dissected and undulating topography, water erosion, less developed irrigation, small size of land holdings, etc. Rest is the *bet* areas where water-logging is the main problem. All these factors affect farmer's decision making capacity. Thus, farmers grow number of crops because they don't want to take any sort of risk. Agriculture in these areas is basically subsistence. So, all these factors lead to high crop diversification in these areas.

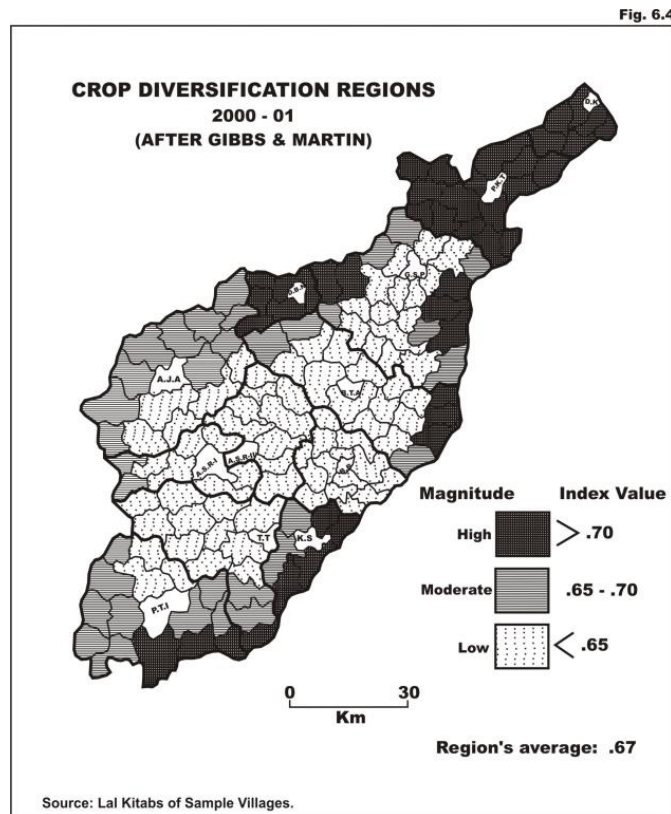


Table 6.4

Patterns of Crop Diversification (2000-01)
(After Gibbs and Martin)

Category	Index Value	Frequencies
High	>.70	39
Moderate	0.65-0.70	34
Low	< 0.65	77

Source: Lal Kitabs of Sample Villages.

2. Areas of moderate crop diversification (0.65 to 0.70): Category of moderate crop diversification is found in small patches in eastern and western parts of Gurdaspur and Batala tehsils, Ajnala tehsil except its eastern stretch, a small patch in southern tip of Amritsar-I tehsil, small patches in eastern parts of Tarn Taran tehsil and few patches in eastern and south-western parts of Patti tehsil. In these areas, water-logging, saline sub-soil water, small size of land holdings and comparatively less developed socio-economic environment, etc. are the main reasons responsible for moderate magnitude of crop

diversification.

3. Areas of low crop diversification (<0.65): Low crop diversification category is found in the central parts of study region. It comprises the major central parts of Gurdaspur and Batala tehsils, Baba Bakala tehsil, Amritsar-II tehsil, Amritsar-I tehsil except its southern part, eastern stretch of Ajnala tehsil, Tarn Taran tehsil except its eastern part and northern part of Patti tehsil. Main reasons for low magnitude of crop diversification are fertile soils, excellent network of irrigation both by canals and tubewells, introduction of high yielding varieties of seeds of wheat and rice, easy access to markets, developed agricultural infrastructure and higher economic returns from wheat and rice crops as compared to other crops. All these factors have led to the selection of few crops which yield low magnitude of crop diversification in these areas. Thus, the trend is towards crop specialisation in this category.

From the above facts, it is revealed that areas with unfavourable physical environment, less developed agricultural infrastructure and small size of land holdings have recorded high crop diversification, whereas areas having developed agricultural infrastructure, mechanised farming, improved varieties of seeds, etc. have recorded low degree of crop diversification. But areas with unfriendly physical environment and developed agricultural infrastructure have experienced moderate degree of crop diversification.

II. Patterns of crop diversification after Singh, (2000-01)

Singh's method of crop diversification has been used to know the magnitude of crop diversification for 2000-01. The index value of overall pattern of crop diversification in the study region is found 28.7 which vary from 18.2 in Chamror village of Dhar Kalan tehsil to 33.2 in Jandiala village of Amritsar-II tehsil. It has been found that the index of crop diversification has great spatial variations in the study region. The variations in crop diversification are shown in fig. 6.5 and table 6.5.

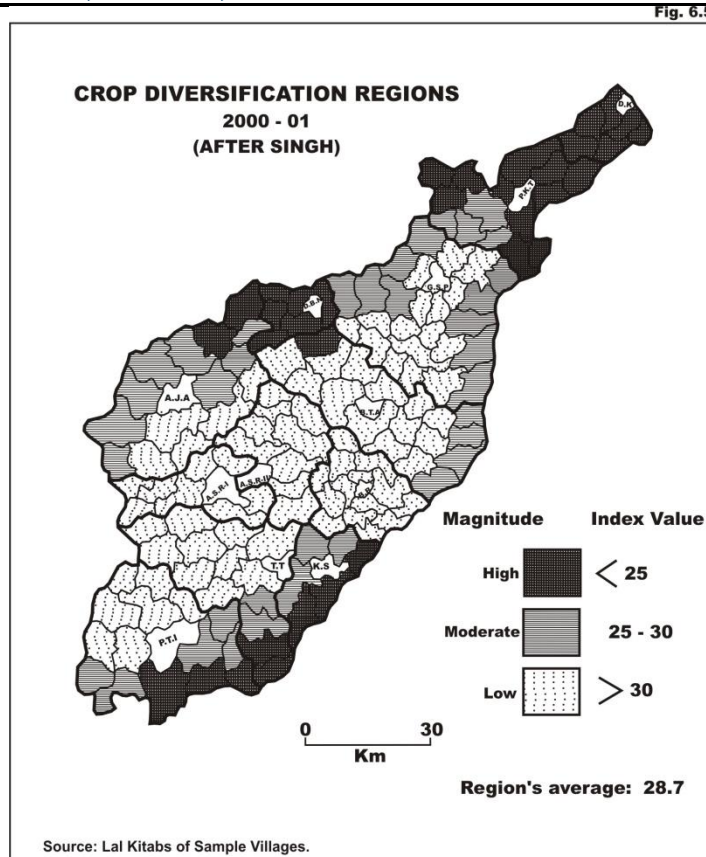
Table 6.5

Patterns of Crop Diversification, (2000-01)

(After Singh)

Category	Index Value	Frequencies
High	< 25	32
Moderate	25-30	36
Low	> 30	82

Source: Lal Kitabs of Sample Villages.



1. Category of high crop diversification (<25): High crop diversification is found in the Dhar Kalan tehsil, north-western and eastern parts of Pathankot tehsil, Dera Baba Nanak tehsil, few patches in northern parts of Ajnala tehsil, a small patch in western part of Batala tehsil, eastern stretch of Khadoor Sahib tehsil and eastern parts of Tarn Taran tehsil and eastern parts of Patti tehsil. All these areas are suffering from physical constraints. For instance, areas of Dhar Kalan and Pathankot tehsils have dissected topography, undulating plains, infertile soils, soil erosion and lack of developed irrigation. While other areas are either water-logged or having saline sub-soil water. All these factors have led to the growing of large number of crops which is resulted into high magnitude of crop diversification.

2. Category of moderate crop diversification (25-30): Moderate crop diversification is seen in the central and southern parts of Pathankot tehsil, eastern and western stretches of Gurdaspur tehsil, eastern stretch of Batala tehsil, western stretch, and a few patches in central parts, Khadoor Sahib tehsil except its eastern stretch, and a few patches in eastern and southern part of Patti tehsil. Main reasons for moderate crop diversification in this category are water-logging in Bet areas, while infertile soils and less developed irrigation in other parts.

3. Category of low crop diversification (>30): Magnitude of low crop diversification is found in central areas of the study region. It comprises the central parts of Gurdaspur tehsil, central parts of Batala tehsil, Baba Bakala tehsil, Amritsar-I and Amritsar-II tehsils, eastern part of Ajnala tehsil, and northern and central parts of Tarn Taran tehsil

and major parts of Patti tehsil. These areas have fertile loamy soils, flat land, excellent developed irrigation, high degree of mechanisation, etc. All these factors have influenced the farmers to grow only those crops which yield them higher economic returns. Thus resulting into low crop diversification and high crop specialisation.

II. Patterns of crop diversification after Ayyar (2000-01)

To know the magnitude of crop diversification for 2000-01 period, Ayyar's method has also been applied. It shows that the index value of overall pattern of crop diversification in the study region is 20.6. It varies from 11.7 in Toor village of Gurdaspur tehsil to 33.3 in Kot Khalsa village of Amritsar-I tehsil. The variations in spatial distribution of crop diversification are marked with the help of fig 6.6 and table 6.6. Fig 6.6 shows the following three categories.

1. Category of high crop diversification (<15): This category is found in Dera Baba Nanak tehsil and Dhar Kalan tehsil, Pathankot tehsil except few areas in central parts, few patches in eastern and western parts of Gurdaspur tehsil, eastern stretches of Batala tehsil, Khadoor Sahib eastern stretch which runs in Tarn Taran and Patti tehsils. In these areas, physical hindrances are important factor for high crop diversification. For example in Dhar Kalan and Pathankot tehsils dissected and undulating topography, soil erosion, etc., in case of *bet* areas, water-logging. Besides this, size of land holdings is also low in these areas which influence farmers' choice for selection of crops. Thus, all these factors have combinedly led to high crop diversification in this category.

Table 6.6
Patterns of Crop Diversification, (2000-01)
(After Ayyar)

Category	Index Value	Frequencies
High	< 15	39
Moderate	15-20	40
Low	> 20	71

Source: Lal Kitabs of Sample Villages.

2. Category of moderate crop diversification (15-20): The category of moderate crop diversification has 40 frequencies. It includes the central and southern parts of Pathankot tehsil, small patches in eastern, western, and southern parts of Gurdaspur tehsil, north-western parts and few patches in central parts of Ajnala tehsil, Khadoor Sahib tehsil except its eastern stretch, eastern part of Tarn Taran tehsil and Patti tehsil except its south-eastern stretch. In these areas, lack of developed irrigation, problem of water-logging, infertile soils, saline sub-soil water in some areas, etc. have made their impacts on cropping pattern and as a result these areas are having moderate magnitude of crop diversification.

3. Category of low crop diversification (>20): Areas of low crop diversification have 71 sample villages which are found in the central parts of the study region comprising the

central parts of Gurdaspur tehsil, Batala tehsil except its eastern stretch, Baba Bakala tehsil, Amritsar-I and Amritsar-II tehsils, eastern parts of Ajnala tehsil, Tarn Taran tehsil except its eastern parts and the northern parts of Patti tehsil. These areas are gifted with flat land, fertile soils, adequate irrigation facilities and diffusion of green revolution technology which has brought major changes in cropping pattern. Thus, farmers grow selected crops which fetch them higher and assured economic returns. All these factors lead to low crop diversification in these areas.

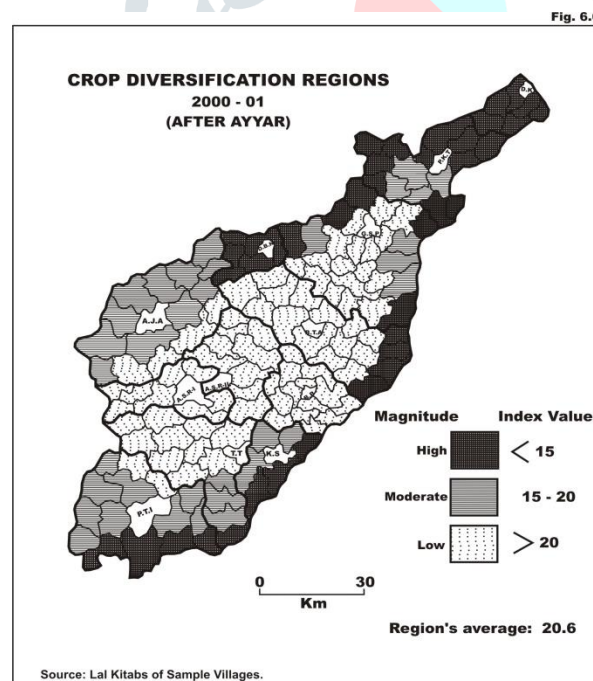
The above discussion reveals the spatial patterns of magnitude of crop diversification for 2000-01 period. The following points emerge from the ongoing discussion. In 2000-01 according to Gibbs and Martin technique, average index value of crop diversification is recorded 0.67 for the study region. There are only 39 frequencies in the category of high crop diversification which is largely confined to the tehsils of Dhar Kalan, Pathankot and areas run along the courses of Ravi and Beas rivers. The areas of moderate magnitude of crop diversification covers 34 frequencies which are lying between areas of high and low crop diversification. While 77 frequencies are found in the category of low crop diversification which covers more than 50 per cent of the total occurrences and comprises the central parts of Gurdaspur, Batala, Baba Bakala, Amritsar-I, Amritsar-II, Tarn Taran, adjoining northern parts of Patti tehsil and eastern parts of Ajnala tehsil.

According to Singh's technique the overall index of crop diversification for the study region is 28.7. This index value ranges between 18.2 in village Chamror of Dhar Kalan tehsil to 33.2 in Jandiala village of Amritsar-II tehsil. According to this technique, magnitude of high crop diversification (<25) is noted in 32 sample villages which are lying in the tehsils of Dhar Kalan and major parts of Pathankot and Dera Baba Nanak tehsils, some parts of Ajnala tehsil and along the river Beas in the tehsils of Khadoor Sahib, Tarn Taran, and Patti. While the category of moderate (25-30) magnitude includes 36 sample villages which are lying along the river courses of Ravi in Gurdaspur and Ajnala tehsils, while along the Beas river in the tehsils of Gurdaspur and Batala. This category is also found in the western parts of Khadoor Sahib tehsil, central parts of Tarn Taran tehsil and southern tip of Patti tehsil. The category of low crop diversification (>30) is found in 82 frequencies which covers more than 60 per cent of total frequencies. This category forms a compact belt which runs in north-south direction in the central parts of the study region. It comprises the central parts of Gurdaspur and Batala tehsils, eastern parts of Ajnala tehsil, Baba Bakala tehsil, Amritsar-I tehsil, Amritsar-II tehsil, major parts of Tarn Taran tehsil and western parts of Patti tehsil.

On the basis of Ayyar's technique, the average index value of crop diversification of 20.6 for the study region is calculated which varies between 17.7 in Toor village of Gurdaspur tehsil to 33.3 in Kot Khalsa village of Amritsar-I tehsil. According to Ayyar's technique, the category of high crop diversification embraces 39 frequencies and covers

the Dhar Kalan tehsil, Pathankot tehsil (except central parts), Dera Baba Nanak tehsil, and areas lying along the rivers Ravi and Beas in the tehsils of Gurdaspur, Batala, Khadoor Sahib, Tarn Taran and Patti, The category of moderate crop diversification has 40 frequencies which are largely found in major parts of Ajnala and Patti tehsils, western parts of Khadoor Sahib, some parts of Tarn Taran tehsil, some parts of Gurdaspur tehsil and central parts of Pathankot tehsil. The categories of low crop diversification comprises 71 frequencies and cover the tehsils of Gurdaspur (central parts), Batala (central parts), Baba Bakala, Amritsar-I, and Amritsar-II, eastern parts of Ajnala tehsil, major parts of Tarn Taran tehsil and some parts of Patti tehsil. It is an uninterrupted continuous belt which runs in north-south direction.

Thus, from the techniques applied by the present researcher for deriving indices of crop diversification for 2000-01 (Gibbs and Martin, Singh and Ayyar), it is found that the patterns of crop diversification derived by above mentioned each technique are almost similar. The areas which are hilly or undulating or flood plains are having high magnitude of crop diversification. While the uplands which are flat plains and lying in the central parts with well developed agricultural infrastructure have experienced low crop diversification. It is also found that out of these methods, the results of Singh's and Ayyar's techniques are more similar as compared to Gibbs and Martin's technique.



Conclusion

A review of all the three methods selected for this study has shown almost similar results of crop diversification with minor exceptions. On the whole, the trend of crop diversification is from high to low. It is also observed that the category of moderate crop diversification has lost its area very significantly to the category of low crop diversification, while it has gained very few area from the category of high crop diversification. But major gainer during the study period is the category of low crop diversification, because it has expanded significantly in its size and has covered almost

the whole upland plains of the Bari-Doab region. An improvement in agricultural infrastructure during 1980-81 to 2000-01 has affected the magnitude of crop diversification in the study region. In 1980-81 the average index of crop diversification has decreased from 0.71 to 0.67 (after Gibbs and Martin), while according to Singh the index of crop diversification for the study region has increased from 26.2 to 28.7 during the study period where as index of crop diversification after Ayyar's technique has increased from 17.1 to 20.6 during the study period. All this shows that magnitude of crop diversification has declined from high to low. In other words it is towards crop specialisation during the period under present study. It is also observed that the category of low crop diversification has expanded in its size where as the categories of low and moderate magnitudes of crop diversification have shrunk in their size. The above mentioned situation is true in all the methods (Gibbs and Martin, Singh, Ayyar). The main reasons for the trend from high to low crop diversification are expansion in area under rice cultivation, increase in extent of irrigation, increase in use of chemical fertilizers, increase in use of high yielding varieties of seeds, mechanization and remunerative prices of wheat and rice as compare to other crops, etc.

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