



An Analysis Of Long-Term Crop Combination In North-Western Haryana Using Doi's Crop Combination Statistical Method (1990-91 & 2021-22)

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Abstract

Crop combination analysis technique locates and identifies area sharing a significant proportion of crops at higher rank. Which aids in understanding the crop diversification, and operation of a given area, allowing for the creation of agricultural regionalization and a rough sketch of agricultural topology. The present study has been carried out to Monitoring the long-term crop combination followed by the farmers of North-western Haryana. Landsat-5 and Sentinel-2 based remote Sensing processed data has been used from the period of 1990-91 & 2021-22. The Doi crop Combination Statistical method (1959) has been used for the identification of crop combination in the agriculture of North-western Haryana. The major crop are cultivated in North-western Haryana are Wheat, Mustard, Rice, Cotton, Bajra, Gram and sugarcane etc. The lowest deviation has been estimated in two crop combination during the reference period and the highest deviation has shown shift from four crop combination during 1990-91 to mono crop combination during 2021-22. The two-crop combination deviation is estimated is 196.76 during 1990-91 & 14.19 during 2021-22. Thus, the statistical analysis exposed that the two-crop combination is favourable for practicing in the agricultural North-western Haryana.

Keywords: Doi's crop combination, long-term analysis, Satellite data, Crops Rank, Statistical method

Introduction

The crop combination mainly indicates the cultivation of various crops in different seasons in the same agricultural region (Biswas, 2020). In order to analyse the current spatial relationships of crops in relation to one another in agricultural geography and land utilisation, scientists use the notion of crop combination (Nisha, 2015). Combination analysis is the process of looking into how well a region may be farmed by picking several agricultural components and looking at them all at once (Singh et al. 2004). The crop combination help in reducing the possibility of oversimplified generalisation and serves as a foundation for regionalization of the agriculture sector (Mohammad, A., 1978). Combination occurs more frequently than a crop holding a certain isolation in a specific location and a cropping year. The method is used to detect and identify regions that share

a high percentage of crops. It is sometimes referred to as a regional distribution study because it can identify regions that produce rice, wheat, etc (Chakraborty. A., 2012). It has been attempted to illustrate the changes in the crop combination regions between the years of 1990-91 and 2021-22. Since agriculture is the only remaining alternative for the region sustainability and improvement, commercialising agriculture while maintaining ecological balance is essential.

Both agricultural economists and geographers have made excellent use of statistics which is another science, provide them tools to gather, analyse, and interpret information about particular farm issues, it has aided them in their study of agricultural phenomena. Weaver (1954) made the finest effort to define agricultural boundaries. Some of the other agricultural geographers Scott (1957), Doi (1959, 1970), Coppock (1964), Hong (1969), Husain (1982), Singh and Dhillon (2006), who have studied the crop combination regions of various parts of the world and India, each used their own techniques to calculate the crop combination regions (Meena, S., 2021). The present study used the Doi's crop combination statistical method for the study of North-western Haryana crop combination. The Industrial Combination Structure in Tokyo, Japan, employed the Doi's method for the first time in 1957. But the modifications used in crop combinations after 1959.

Study Area-Location and Extent

Haryana is located in the north-western part of India with less than 1.4% of India's land area as well as research area also lies in the north-western part of Haryana. According to the total Geographical area of Haryana 15% is covered by non-agricultural sector while 85% of its area is available of agricultural sector (Vinod & et al., 2021). North-western Haryana is a landlocked area which comprises three major districts of Haryana are Sirsa, Fatehabad & Hisar are shown in figure 1. North-western Haryana accounts for 24.42 percent of Haryana's total land area, with 10798² km. Longitudes extent of North-western Haryana is 74°28'E to 76°19'E, and the latitudinal spans is 28°54'N to 29°59'N as shown in figure 1.

The major crops like Cotton, Rice, wheat, sugarcane, bajra, gram and mustard are grown in the Rabi and Kharif seasons in the research region (North-western Haryana). The current study, which uses Doi's crop combination method to analyse crop combination of north-western Haryana, can help to boost food grain output while also ensuring that our land resources are used sustainably.

Location Map of Study Area

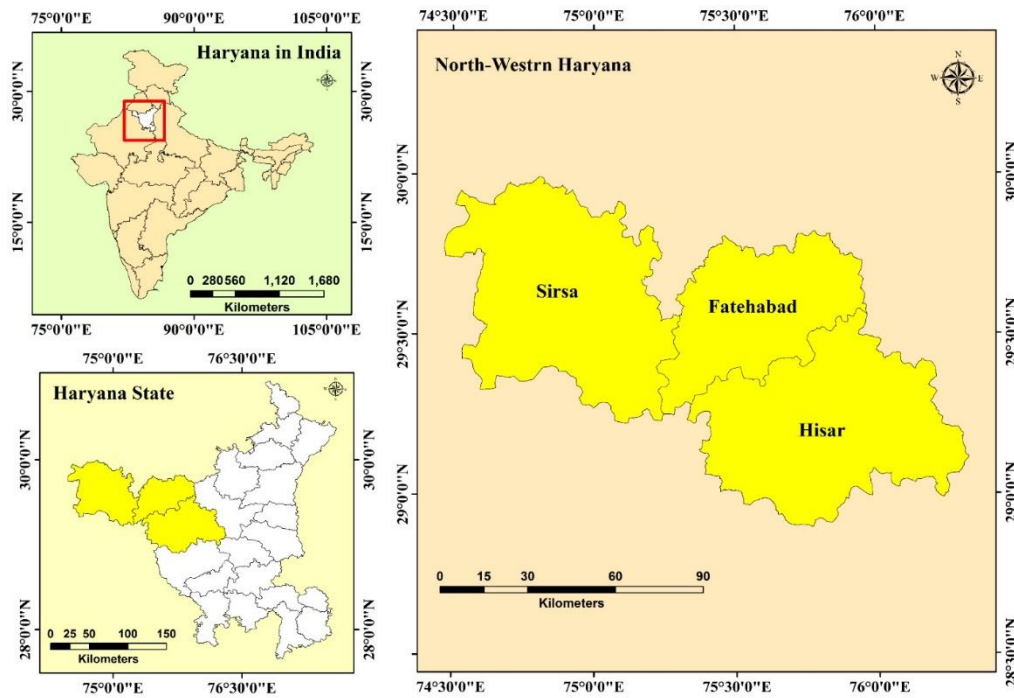


Figure-1: Locational map of Study area

Aim and Objective of the study

- To Examine the crop combination of North-Western Haryana during 1990-91 & 2021-22

Methodology

The crop combination of North-western Haryana is estimated with the help Doi's crop combination method and the basic data is acquired from satellite. After the extorting crop wise data, the data is arranged in descending order. After that the data is arrange according to crop types and theoretical percentage base of Doi's method has been implemented. Thus, the difference between gross cropped area percentage & theoretical actual base percentage has been calculated. The calculated data has been squared in the next step and $\sum d^2$ has been estimated. Thus, the lowest deviation has been consider as favourable crop combination for North-western Haryana.

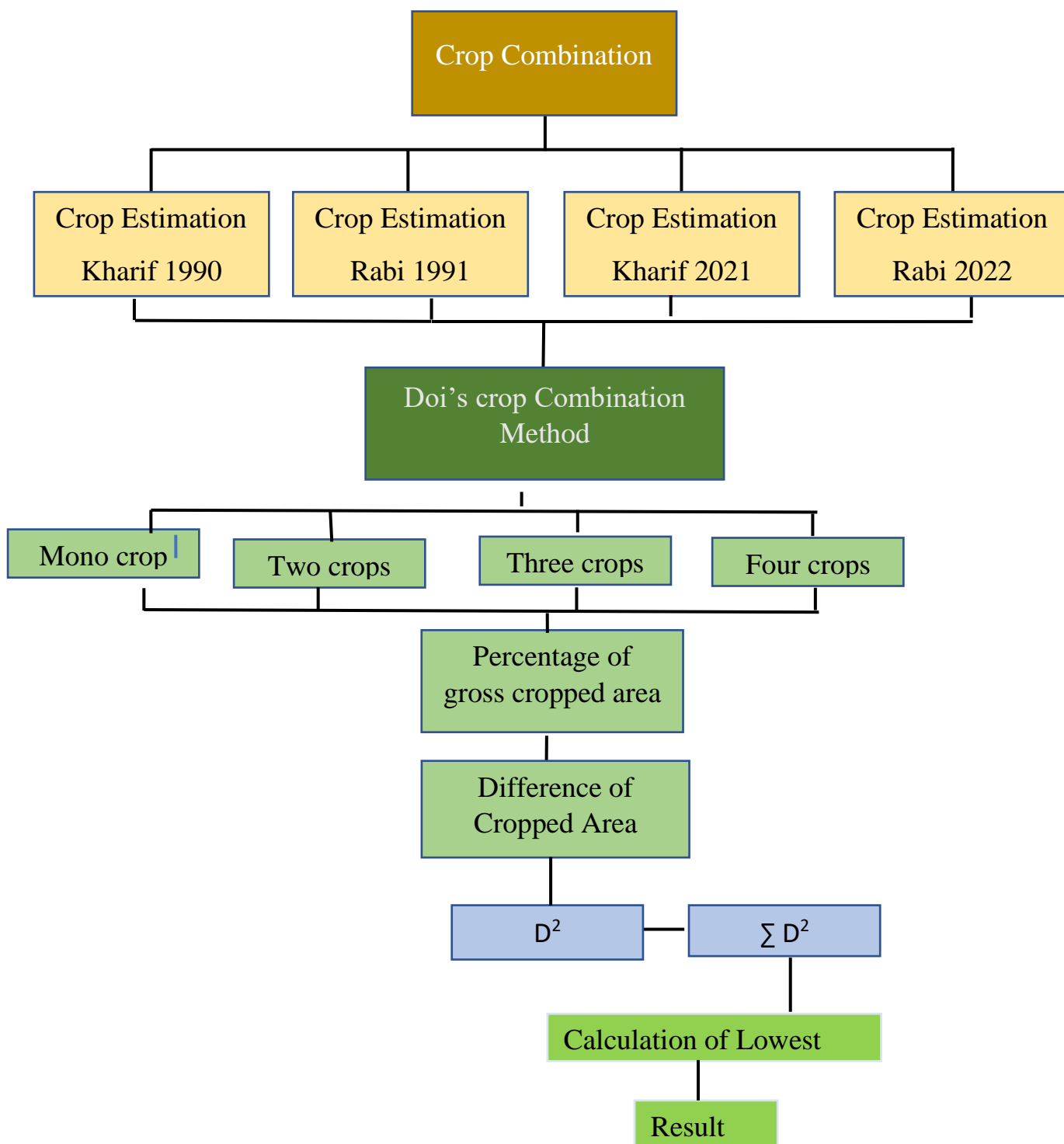


Figure-2: Flow chart of Methodology.

Result & Discussion

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In the North-western Haryana 7 Major & minor crops are Identified with the help of satellite processed data from 1990-91 & 2021-22 as shown in the table 1 & table 2. Crop combinations in North-western Haryana for two agriculture years are given in table-1 and table-2 that clearly revealed that the percentage share of crops in North-western Haryana are predominated during 1990-91 are Cotton, mustard, Wheat & Rice while the crops percentage share shift to crops namely wheat, cotton & Rice during the period of 2021-22. The predominancy of more crops in the study area is associated with the subsistence agricultural production rather than commercial (Prasad. D. J., & et. al. 2021). Cotton is a cash crop which was dominant during 1990 while wheat is a staple crop which is dominant during 2022. This development is impacted by the rise in demand for food grains brought on by population expansion, rising market prices, and inflation. People want to grow the fundamental grains in order to meet their demands.

North-western Haryana has considered an ideal unit for the identification of the crop combinations. For the Calculations of North-western Haryana crop combinations total cropped area in percentage is used. After the calculation of percentage of each one of crop in terms of total cropped area and the crop data are arrange in descending order. The percentage of crops calculations are shown in table;1 & table;2 and the crop combination calculation are shown in table; 3 & table: 4 based on Doi's crop combination Statistical method given in 1959.

Area under different crops in North-Western Haryana (2021-22)	
Kharif/Rabi	2021 (Area in percentage)
Rice	37.31
Cotton	51.34
Bajra	0.43
Wheat	53.53
Mustard	24.60
Gram	0.41
Sugarcane	0.01
Non- agriculture	32.38
Total	200

Table-1: Area under different crops in North-Western Haryana (2021-22).

Area Under Different Crops in North-Western Haryana 2021-22

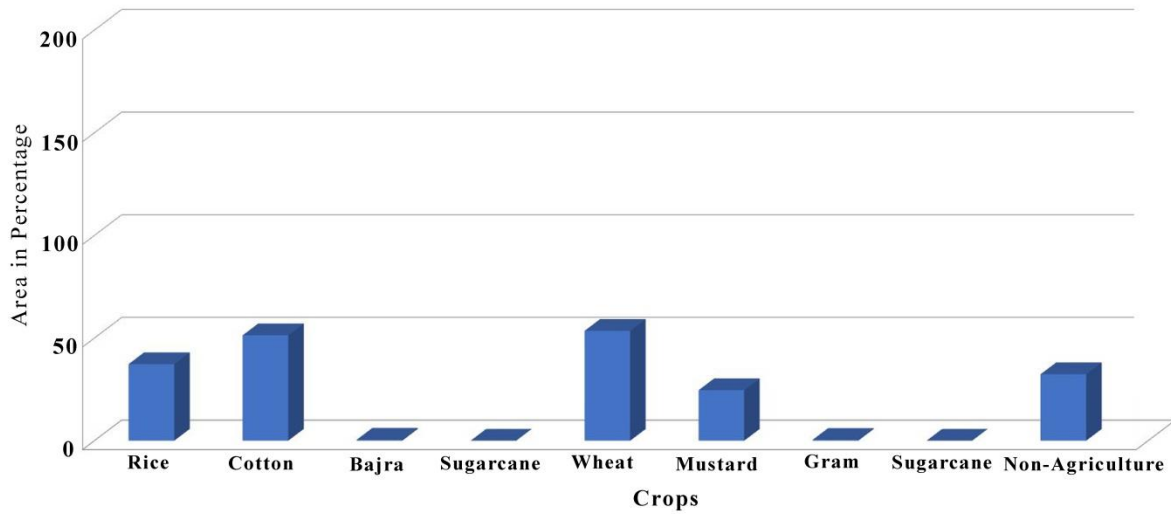


Figure-3: Graph of Area under different crops in North-Western Haryana (2021-22).

Area under different crops in North-Western Haryana (1990-1991)	
Kharif/Rabi	1990 (Area in percentage)
Rice	15.99
Cotton	45.31
Bajra	8.77
Wheat	21.95
Mustard	36.79
Gram	11.91
Sugarcane	0.01
Non-Agriculture	59.26
Total	200

Table-2: Area under different crops in North-Western Haryana (1990-1991).

Area Under Different Crops in North-Western Haryana 1990-91

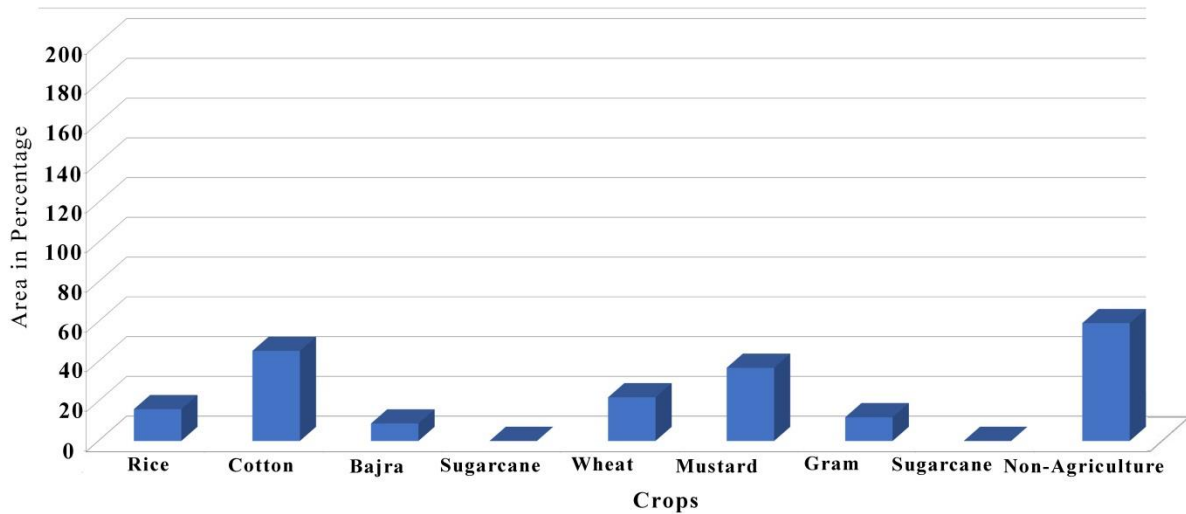


Figure-4: Graph of Area under different crops in North-Western Haryana (1990-91).

Using Doi’s crop combinations four groups are categorized namely Mono crop, two crops, three crop, and four crop combination which are shown below in table 3 and table 4. The crop combination having the lowest (ϵd^2) will be considered the crop combination according to Doi’s crop combination statistical method. Doi crop combination approach estimates that the two-crop combination during the reference period had the lowest deviation, while the highest deviation has shown shift from four crop combination during 1990-91 to mono crop combination during 2021-22. The two-crop combination deviation is estimated lowest is 196.76 during 1990-91 as shown in table 3 & 14.19 during 2021-22 as shown in table 4. The statistical analysis exposed that the two-crop combination is favourable for practicing in the agricultural North-western Haryana.

Table:3

Crop combination in North-western Haryana (1990-991)										
Types of crop combination	Mono crops	Two Crops		Three crops			Four crops			
% of theoretical base [X]	100	50	50	33.3	33	33.3	25	25	25	25
% of gross cropped Area [XI]	45.31	45.31	36.78	45.31	36.78	21.24	45.31	36.78	21.24	15.98
Difference (d)	54.69	4.69	13.22	11.98	3.45	12.09	20.31	11.78	3.76	9.02
D square	2991.00	22.00	174.77	143.52	11.90	146.17	412.50	138.77	14.14	81.36

ϵd^2	2991.0 0	196.76	301.59	646.76
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Table: 4

Crop combination in North-western Haryana (2021-22)										
Types of crop combination	Mono crops	Two Crops		Three crops			Four crops			
% of theoretical base [X]	100	50	50	33.3 3	33.3 3	33. 33	25	25	25	25
% of gross cropped Area [XI]	53.52	53. 52	51. 34	53.5 2	51.3 4	37. 3	53.5 2	51.3 4	37.3	24. 59
Difference (d)	46.48	- 3.5 2	- 1.3 4	- 20.1 9	- 18.0 1	- 3.9 7	- 28.5 2	- 26.3 4	- 12.3	0.4 1
D square	2160.3 9	12. 39	1.8 0	407. 64	324. 36	15. 76	813. 39	693. 80	151. 29	0.1 7
ϵd^2	2160.3 9	14.19		747.76			1658.64			

Conclusion

The shift of primary crops in North-western Haryana towards the production of food grains rather than commercial crops during reference period. In North-western Haryana has seven crops in combination which are Wheat, Cotton, Rice, Mustard, Bajra, Gram & Sugarcane. The statistical analysis exposed that the two-crop combination is favourable for practicing in the agricultural North-western Haryana. Recently, the need of the hour in the North-western Haryana is the introduction of new crops combination that use less water and can be cultivated in a variety of climatic conditions.

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