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**CROPPING PATTERN AND CROPPING REGIONS IN PUNJAB, PAKISTAN**

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**ABSTRACT**

*Agriculture is the mainstay of the economy of Pakistan. It provides food grain to 207 million population and plays a key role in the manufacturing and export sector of the economy. The province of Punjab accounts for 50 percent population and 26 percent of the area located in the upper Indus River plain of Pakistan. It is the food basket and backbone of the agro-economy of Pakistan. Its share in the total cultivated area and cropped area of Pakistan are 55 percent and 72 percent respectively. About 82 percent of wheat, 67 percent rice, 69 percent cotton and 68 percent sugarcane of area under cultivation pertain to Punjab. Therefore issues of food security and declining agriculture growth in Pakistan largely depend upon the agriculture performance of Punjab. This paper evaluates the importance of Punjab in the crops production of country. Statistical techniques of the Crop Diversification Index (CDI) and the Crop Concentration Index (CCI) are used to compute cropping patterns and cropping regions in Punjab. The breakpoint method is used to delineate regions of major crops grown in Punjab. Weaver and Thomas's statistical models are used to quantify crops combination regions in the province.*

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**Keywords :** Punjab, Cropping region, Crops diversification, Cropping pattern

**INTRODUCTION**

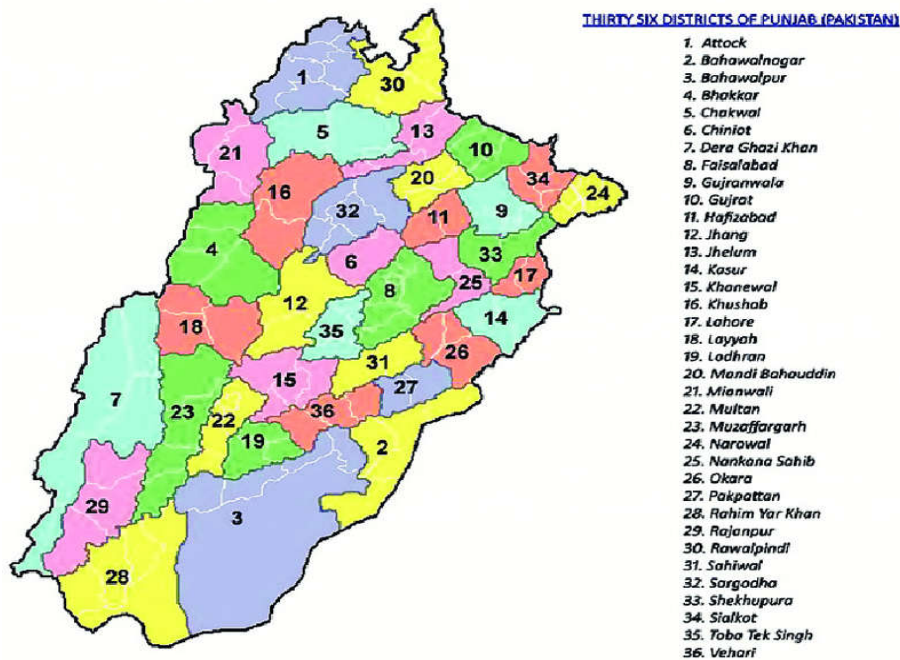
Pakistan is the sixth most populated country in the world where 64 percent of the population live in rural areas, agriculture provides livelihood to them. Agriculture, directly and indirectly, affects the economy and social development of the country. Over the last decade, the performance of the agriculture sector has fallen short of the desirable level. Several factors led to declining overall agriculture in the country. The interference of IMF, overwhelming foreign loan and debt burden on the economy are factors that do not provide fiscal space to grant subsidiary to farmers on fertilizer, seed, electricity bill,

machinery, etc. to reduce procurement costs. The performance of government sectors is unsatisfactory to provide technical and financial support against pest hazards like locust attacks on various districts of Balochistan, Sindh, and Punjab provinces. Water scarcity particularly during winter or rabi crop season is an important cause of declining crops production. As a result, declining agriculture growth is a big challenge for the overall economic growth of the country which has already suffered as a result of the Corona pandemic. The agriculture performance of Pakistan largely depends on the province of Punjab which has a lion share in major food crops. Despite improvement in farming techniques and mechanization yield of crops has not yet significantly increased. A large number of farmers still practice the traditional method of farming. The growers are unhappy because of the increasing procurement cost which is now double as compared to three years ago due to the rapid decline of the currency exchange rate. Despite having a large network of canals and subsurface sweet water the issue of water deficiency exists in the winter season and wheat which is grown in all districts of Punjab is affected. The increasing competition between cotton and sugarcane crops has affected the production of the cotton crop and Pakistan which was the 4th largest producer is now importing cotton for its textile manufacturing.

#### **STUDY AREA**

The province of Punjab is located in the subtropical region (latitude 28 degrees north to 34 degrees north and longitude 69 degrees east to 75 degrees east), bounded by Khyber Pakhtunkhwa province in the north, east by India, west by Balochistan province, and south by Sindh province. It is the fertile land of the Indus plain, drained by the Indus River and its tributaries Jhelum, Ravi, Chenab, and Sutlej. The province of Punjab is administratively divided into 36 districts (Fig 1). Rawalpindi, Chakwal, Attock are located on the Potowar plateau while districts Khushab, Mianwali, Bhakkar, Leiah, and Dera Ghazi Khan are located in the Thal desert and piedmont region of Punjab. Bahawalnagar, Bahawalpur, and Rahimyar Khan are located in the Cholistan desert region of Punjab. Gujranwala, Gujrat, Jhelum, Lahore, Hafizzabad, Pakpattan, Kasur, Okara, Sahiwal, Khanewal, Multan, Vihari, Faisalabad, Jhang, Toba Tek Singh, Rajanpur, etc. are

fertile cropland of old flood plains of Indus, Jhelum, Chenab, Ravi Sutlej and Beas rivers.



**Figure-1: Administrative Districts of Punjab**

Irrigated crops farming in Punjab was largely developed during the British colonial period in the late 19<sup>th</sup> and early 20<sup>th</sup> century when Punjab was part of British colonial India. Britishers introduced barrage and head works canal irrigation system to irrigate arid land of Punjab and expanded crops farming. The colonial rulers had two objectives; i.e. to establish a loyal local feudal society that suppressed peasant population who were against colonial occupation and ii. to expand food crops farming like wheat, rice, sugarcane etc. and fiber crops like cotton to fulfil the requirement of food in Britain and to provide raw material for textile industries of England. The British colonial ruler granted newly developed arable lands to their loyals and supporters. Thus Britishers had succeeded to establish a loyal feudal class in Punjab which is still influential in the politics of Pakistan.

**PHYSICAL SETTING**

The physiographic divisions of Punjab can be identified in the north by the salt range and Potwar plateau while the interfluves located between Indus River and Jhelum River called Sindh Sagar Doab, Rachna Doab between Jhelum River and Chenab River, Chaj Doab located between Chenab and Ravi rivers and land between Ravi and Sutlej rivers is called Bari Doab. These interfluves are the fertile lands of Punjab where 70 percent of cropland exists (Fig-2). These interfluves can be further divided into the active flood plain, old flood plain, and alluvial terraces. The two main desert regions of Punjab are dominated by dunes, the Cholistan desert is located in the south-eastern districts of Bahawalnagar and Bahawalpur while the west Thal desert is located in the districts of Khushab, Leiah, and Bhakkar districts.

The soil of Punjab is fertile derived from the river's eroded sediments. Soils of flood plains and interfluves are loamy clay and loamy silt while in the desert regions sandy loam rich in calcium carbonate exists. Loamy clay soil is the most appropriate soil for rice cultivation. Therefore rice is an important summer crop in the districts of Sialkot, Narowal, Gujranwala, Gujrat, Lahore, Kasur, etc. Soils in the eastern and southern districts Jhang, Leiah, Bhakkar, etc. are sandy and silt loam suitable for gram crops. Due to alkaline characteristics of soil salinity causing loss of cropland while subsurface water is salty in many areas.

The climate of Punjab is arid and semi arid with hot summer and mild winter. The mean monthly temperature of January (coolest month) varies from 10.4 to 13.6 degrees Celsius while the mean monthly temperature of July (the hottest month) varies from 30.5 degrees Celsius to 35.0 Celsius. The temperature condition is suitable for crops like wheat, rice, cotton, sugarcane, pulses, vegetable, and fruits. Most of the areas of Punjab receive rainfall in summers months (June to September) because of the south west summer monsoon moist winds that enter in Punjab from Indian territory where they give more rain. Thus Punjab receives a relatively low amount of rainfall as compared to neighbouring Indian territory. The total annual rainfall in Punjab varies from 179 mm to 700 mm. The number of rainy days varies from 20 to 70. Due to low and variable rainfall, crops farming largely depends on canal irrigation system.



**Figure-2: Arable Interfluves Land of Punjab (Pakistan)**

#### **OBJECTIVES OF STUDY**

The main objectives of this study are:

1. To evaluate the performance of crops grown in various districts of Punjab.
2. To study the cropping pattern of Punjab by using statistical techniques of crops diversification index and crops concentration index
3. To compute cropping regions of major crops grown in Punjab.
4. To find crops combination pattern in districts of Punjab and delineate crops combination regions.

#### **SOURCES OF DATA AND METHODOLOGY**

The study is based upon secondary sources of data obtained from Agriculture Statistics of Pakistan, Agriculture Census of Pakistan, and Economic Surveys of Pakistan. These crops statistics and agriculture surveys are reliable sources of data published by the government of Pakistan.

To measure the diversification of crops, the crop diversification Index formulated by Gibbs Martin is used (Singh, 1987, Kumar, 2015, Naya, 2019 etc.)

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

The index value ranges between 0 and 1. The value 1 represents extreme diversification and 0 indicates extreme concentration on one crop.

Crop Concentration Index (CCI) refers to the density or aerial occupancy of a crop in a region. The occupancy of a crop is determined largely by topography and climate. It is calculated by following the formula (Shafi, 2006).

$$\text{Crop Concentration Index(CCI)} = \frac{\text{Area of a crop in district}}{\text{Area of all crops in district}} + \frac{\text{Area of a crop in province}}{\text{Area of all crops in province}}$$

American geographer Weaver in 1954 was the first who statistically developed a formula of computing crops combination of districts. According to this method, if only one crop is grown, it is called monoculture, that is 100 percent is supposed to be occupied by a crop in the entire region. If two crops are cultivated in that district, it is called a two-crop system that is 50 percent is supposed to be occupied by each crop. Similarly, if five crops are cultivated in the district it is called a five-crop region, and 25 percent is supposed to be occupied by each crop. Weaver used the method of standard deviation to find the combination in which there was the least deviation. The model can be modified (Weaver, 1954, Kasem, 2011, Dasgupta, 2014 etc.)

$$\text{Weaver Model} = \sqrt{\sum \frac{d^2}{n}}$$

In 1963 Thomas used a modified method of Weaver's model of least deviation (Thomas, 1964 and Khatun, 2015). In this method, all crops grown in a district are considered in the calculation.

## RESULT AND DISCUSSION

Pakistan has not achieved desired results of stable agriculture growth during the last 5 years which has remained low in between 0.5 to 2.5 percent. The country has been facing a serious challenge of food security due to high inflation, unstable growth of wheat and other

crops, government mismanagement, and the high price of food crops in the international market. The agriculture economy of Pakistan depends on the agriculture performance of Punjab province. During the last 10 years, no significant growth in crops production and yield are recorded. High procurement costs and lack of subsidy on seed, fertilizer, pesticide, and electricity have affected the stable growth of major crops.

#### **CROPPING PATTERN**

Two cropping seasons exist in Punjab, the winter season (November to April) crops, called rabi, and other is summer season (June to October) crops, called Kharif. Wheat, maize, pulses are rabi crops while rice and cotton are Kharif crops. Sugarcane, fodder, and vegetables are grown throughout the year. The province of Punjab is dominated by all major crops of Pakistan like wheat, cotton, rice, sugarcane, vegetable, fodder, and pulses. Punjab accounts for 75 percent of the area under wheat crop in Pakistan, 64 percent of the area under rice crop, 73 percent of the area under cotton crop, 92 percent of the area under potato, 90 percent of the area under a gram, 64 percent of the area under sugarcane and 94 percent of the area under citrus (Fig-3).

Punjab produces 74 percent of wheat, 51 percent of rice, 65 percent of cotton, 66 percent of sugarcane, 80 percent of pulses mainly gram, 97 percent of citrus, 77 percent of mango, and 95 percent of potato of the country. This is the importance of Punjab in the agriculture economy and food security of Pakistan. The shares of cropped area of various crops indicate that wheat is the dominant crop accounts for 41 percent of the cropped area of Punjab, followed by 15 percent cotton, 14 percent rice, 11 percent fodder, 6 percent pulses, and 4 percent sugarcane (Table-1, Appendix).



Wheat Harvesting by Sickle



Wheat Threshing by Machine



Cotton Plucking



Sugarcane Harvesting

**Fig-3: Wheat, Cotton and Sugarcane Crops**

Wheat is the main crop of all districts of Punjab. Districts that have a share of 50 to 60 percent in the total cropped area are Rawalpindi, Attock, Jhelum, Chakwal, Gujrat and Mianwali. Similarly, 40 to 45 percent rice cropped area in the total cropped area is recorded in districts Gujranwala, Hafizabad, Sialkot, Narowal and Sheikhpura. The share of cotton cropped area 30 to 40 percent in the total cropped area lie in districts Multan, Lodhran, Vehari, Khanewal, Rajanpur, Bahawalpur, Bahawalnagar and Rahimyarkhan. Districts Faisalabad, Chinot and Rahimyarkhan have 10 to 16 percent sugarcane cropped area in the total cropped area of districts. The share of pulses mainly gram 20 to 50 percent cropped area are found in districts Bhakkar, Mianwali and Khushab. The share of oilseed 10 to 15 percent cropped area lie in Attock and Chakwal (Table-1, Appendix).

#### **CROP DIVERSIFICATION INDEX AND CROP CONCENTRATION INDEX**

Punjab is the land of two cropping seasons. There is no district where a single crop is grown. Each district produces more than two crops. The selection and preference of crops grown in the district depend upon farmers' decisions based upon local conditions, previous year profit-loss status, and the current market price of crops. Government has no direct interference in land utilization and selection of crops. Government creates a market force to increase the demand for crops or increase support purchasing price of crops, especially for wheat.

Crop diversion Index is a method to measure crops diversification in a district. In Punjab, two cropping pattern is generally practiced. Wheat is the main *rabi* crop in all districts while rice and cotton are generally the main *Kharif* crops. The index value ranges between 0 and 1. The value 1 represents extreme diversification and 0 indicates extreme concentration on one crop. The values of CDI of all districts are calculated ranging between 0.58 to 0.78, which shows in all districts multiple cropping patterns exist. Farmers do not rely on anyone crop and grow various crops depending upon market price and local requirements. Sargodha has the highest crops diversification value which is 0.78 where five main crops wheat, rice, fodder, orchard, and sugarcane are grown. In Sahiwal, Pakpattan, Okara have CDI value 0.77. The lowest CDI value 0.58 is found in Sheikhpura where two main crops wheat and rice are grown (Table-2, Appendix).

Crop Concentration Index (CCI) is another parameter used to determine cropping pattern refers to the density or aerial occupancy of a crop in a region. The occupancy of a crop is determined largely by topography and climate. The crop concentration index of all important crops of districts is computed. It is an important method to evaluate the importance of each crop grown in a district. The values of CCI ranging from 0.67 to 1.39 show that wheat is grown in all districts of Punjab. This is because wheat is the staple food in Pakistan. It is profitable because government determines its supporting price which is higher than the open markets. Government purchases wheat directly from growers. The CCI values of rice crop 0.64 to 1.38 are concentrated in districts Gujranwala, Hafizabad, Sialkot, Narowal, Nankanasahib, Lahore, Pakpattan, Sahiwal, Khanewal, Dera Ghazi Khan and Muzaffargarh. These districts have clay loam soil and canals irrigation which are favourable for growing profitable export rice variety crops. The CCI values of cotton crop 0.6 to 3.0 are concentrated in districts Multan, Lodhran, Vehari, Sahiwal, Khanewal, Dera Ghazi Khan, Rajanpur, Muzaffargarh, Bahawalpur, Bahawalnagar and Rahimyar Khan. The loamy soil and hot sub tropical arid climate with the facility of canal irrigation provide excellent condition for growing cotton crops in these districts. The CCI values 3.3 to 8.1 of pulses(mainly gram) exist in districts Khushab Minawali, Bhakkar and Leih where sandy loamy soil and moderate winter condition give excellent production of gram. The CCI values of sugarcane crop lie between 0.9 to 4.6. The highest CCI value 4.6 is computed for Faisalabadwhile Jhang, Chinot, Sargodha, Rahimyar Khan, Khushab and Muzaffargarh are also recorded high CCI values of sugarcane crops. Because of the establishment of sugar industries in these districts, farmers prefer to grow sugarcane because of high profit. The CCI values (4.4 to 15.4) of oilseed indicate that districts Chakwal, Attock, and Rawalpindi are important oilseed producing districts. The CCI values (4.3 to 10.3) of vegetables (mainly potato) indicate districts Attock, Jhelum, Kasur and Okara are main vegetables growing regions in Punjab. Punjab is the region of cattle farming and milk production in Pakistan. Therefore fodder is an important crop that is grown in every district of Punjab. However the CCI values of Fodder crop indicate Mandibahauddin and Kasur are main fodder growing districts (Table-2, Appendix).

**CROPPING REGION**

The cropping regions of Punjab are generally based upon crops grown in the cropping seasons of rabi and Kharif. Wheat, rice, cotton, sugarcane, oilseed, maize, vegetable, pulses, and fodder are the main crops grown in districts of Punjab. Data about areas under various crops in districts are available, used to find cropping regions of different crops. The breakpoint method is used to classify the region of each crop as main, secondary, and minor categories.

It comes out that wheat is an important crop in all districts of Punjab because it is the staple food for the citizen of Pakistan. The procurement of wheat is profitable because of rising demand and selling prices. Despite its lion share in all crops procured in the country, wheat is imported constantly to maintain the food supply chain in the country and control food inflation. Smuggling of wheat to Afghanistan, inter-provinces restriction of wheat transportation, delay of wheat supply from Sindh province, hoarding of the crop, the high price of wheat in the international market have created serious political problems for the government of Punjab. The main wheat-growing regions are comprised of districts Rahimyarkhan, Bahawalnagar, Bahawalpur, D. G. Khan, Muzaffarkhar, Sargodha, Faisalabad, Jhang, Bhakkar and Gujranwala (Table-3, Appendix).

Rice is another important crop. It is not a staple food crop, therefore it is an important cash crop. Its variety of *Basmati* is an exported crop. Gujranwala and Sialkot are the main rice-growing region. Sufficient water and loamy clay soil support rice cultivation. Cotton is an important value-added textile export-based cash crop. Unfortunately, the production of cotton crops has declined during the last decade and export-oriented textile industries have imported cotton. Competition with sugarcane crops and crop failure due to rain and flood hazards are possible factors of declining cotton-growing areas in the central and southern Punjab. Rahimyarkhan, Bahawalnagar, Muzaffargarh, and Bahawalpur are the main cotton-growing regions. The interest of political ruling elites in establishing sugar industries has badly affected growing areas of other crops, particularly cotton. These industries are mostly established in central and southern Punjab where the demand of sugarcane crop has increased. Faisalabad, Rahimyarkhan, Sargodha, Jhang Muzaffargarh are the main sugarcane growing regions. Maize is grown in Punjab as a grain crop and fodder. Okara, Sahiwal and Pakpattan are main maize crop region. Pakistan

imports edible oil and pulses because of low production. Gram is the main type in pulses, grown in Bhakkar, Layyah, Mianwali and Khushab. Chakwal and Attock are the main oilseed growing regions. Punjab is the main important milk-producing region of Pakistan. Milk-producing cattle farming is associated with growing fodder. Sargodha, Kasur, Bhakkar, Bahawalnagar, Jhang and Faisalabad are important districts of fodder growing crops. Punjab is dominated by vegetables mainly potato crops and fruits (citrus and mango). Okara, Pakpattan, Sahiwal, and Kasur are important districts of the vegetable growing region while Sargodha, Multan, Muzaffargarh and Rahimyarkhan are the main fruits growing districts (Table-3, Appendix).

#### **CROP COMBINATION REGION**

In the province of Punjab, multiple crops are grown in every district. Therefore it is important to quantify the pattern of multiple growing regions. The dominant cropping region of districts is simply based upon the highest share of cropping land of that crop of a district. It comes out that wheat is dominated crop in the majority of districts of Punjab. Seven districts of Punjab are dominated equally by two crops wheat in the rabi season and rice in the Kharif season.

American geographer Weaver in 1954 was the first who statistically developed a formula of computing crops combination of districts. The method is widely applied in various countries of the world like Bangladesh, India, etc. (Islam, 1965, Singh, 1987, Kasem, 2011, Dasgupta, 2014 etc.). According to this method, if only one crop is grown, it is called monoculture, that is 100 percent is supposed to be occupied by a crop in the entire district. If two crops are cultivated in that district, it is called a two-crop system that is 50 percent is supposed to be occupied by each crop. Similarly, if five crops are cultivated in the district it is called a five-crop region, and 25 percent is supposed to be occupied by each crop. Weaver used the method of standard deviation to find out the combination of crops. It comes out from Weaver's model that out of 36 reported districts of Punjab 7 districts pertain to 2-cropping regions which are districts of Gujranwala, Hafizaabad, Sialkot and Sheikhupura located in northern Punjab where wheat and rice are the main crops. Lodhran, Rajanpur, and Bahawalpur located in southern Punjab is another two cropping regions where wheat in rabi and cotton in Kharif are grown. The three

cropping regions are the combination of three crops. Fodder is grown as 3rd important crop while wheat and rice/cotton are the first two important crops. Out of 36 districts, 18 districts belong to a 3-cropping region. The wheat-rice-fodder region includes districts Gujrat, Narowal, Mandibahauddin, Lahore, Kasur, Nankanasahib, and Jhang. The wheat-cotton-fodder region includes districts Vehari, Multan, Khanewal, and Bahawalnagar. In Faisalabad wheat is first and sugarcane is the second important crop, replacing cotton while fodder is 3rd main crop. In Rahimyar khan wheat, cotton and sugarcane are the main crops. In Bhukkar and Khushab Pulses (mainly gram), wheat and fodder are the three main crops while in Mianwali wheat, pulses and cotton are the three main crops. Chakwal is three crops region of wheat, oilseed, and fodder while in Jhelum wheat, Bajra and maize are the main crops (Table-4, Appendix).

The four cropping regions are comprised of 7 districts which include Rawalpindi (wheat-maize-fodder-oil-seed), Okara (wheat-rice-fodder-cotton), Toba-Tek. Singh (wheat-cotton-rice-fodder), Chinot (wheat-fodder-rice-sugarcane), Sargodha (wheat-fodder-rice-orchard), Sahiwal, and Dera Ghazi Khan are dominated by wheat, cotton, fodder, and rice crops. In 1963 Thomas used a modified method of Weaver's model of least deviation (Ashfaq, 2008, Acharya, 2011, Khatun, (2015) etc. In this method, all crops grown in a district are considered in the calculation. The result of the Thomas method is more or less the same. The importance of this model is that in Weaver's model vegetable (potato) is not shown in the cropping region of any district of Punjab while in the Thomas model vegetable (potato) is considered in districts Okara and Jhelum as the fifth important crop. Similarly, Cotton is considered in Jhang and Bhakkar as four cropping regions (Table-4, Appendix).

## CONCLUSIONS

The province of Punjab is the core of the agro-economy of Pakistan. Food security of the country depends upon Punjab which is dominated in procurement of wheat, rice, cotton, sugarcane, pulses, oilseed, and vegetable crops.

Crops are grown in Punjab in two seasons *rabi* (winter) and *Kharif* (summer). Wheat is the main *rabi* crop in all districts of Punjab. Rice and cotton are the main *Kharif* crops. In every district of Punjab, multiple cropping patterns exist. Application of statistical techniques

like Crops Concentration Index and Crops diversification Index have proved good methods to determine cropping patterns of Punjab. The break point method is a simple and useful method to determine main, secondary and minor regions of all main crops cultivated in Punjab. The Weaver and Thomas models are effective techniques to compute crops combination regions in districts of Punjab. The results of the models show that the three crops combination region is dominated in the province of Punjab.

## APPENDIX

Table-1  
Share of different crops area in total cropped area in Percentage of districts of Punjab

District	1 Wheat	2 Rice	3 Cotton	4 Sugar cane	5 Fodder	6 Maize for grain	7 Pulses	8 Oil seed	9 Orchards	10 Vegetabl e	11 Jawar/ Millet
PUNJAB	41	14	15	4	11	1	6	2	1	1	2
Rawalpindi	57	--	--	--	08	16	2	7	--	1	6
Attock	60	-	--	--	07	8	1	16	--	1	3
Jhelum	60	3	1	1	05	6	2	2	--	06	12
Chakwal	53	--	--	--	08	--	5	23	--	--	06
Gujranwala	44	44	--	--	09	--	--	--	--	01	--
Hafizabad	43	43	--	--	10	--	--	--	--	--	--
Gujrat	54	17	--	--	16	--	--	01	--	--	08
Mandi	39	35	--	04	14	--	--	--	02	01	--
Bahauddin											
Sialkot	46	43	--	--	07	--	01	--	--	01	01
Narowal	46	40	--	--	08	--	01	--	--	--	03
Lahore	39	35	--	--	21	--	--	--	--	02	--
Kasur	39	20	04	05	19	02	--	01	--	04	--
Okara	38	23	08	02	10	07	--	01	--	08	01
Sheikhupura	46	44	--	--	07	--	--	--	--	02	--
Nankana- sahib	43	33	01	04	13	02	--	01	--	01	--
Faisalabad	44	11	05	16	15	01	--	01	01	01	02
Toba Tek Singh	43	12	14	08	12	3	--	01	02	02	01

Source: Pakistan Agriculture Census and Crops statistics yearbook, 2021, values computed by authors

**Table-2**  
**Crop Diversification Index (CDI) and Crop Concentration Index (CCI)**  
**of major crops in districts of Punjab**

District	Crop Diver. Index CDI	1 Wheat CCI	2 Rice CCI	3 Cotton CCI	4 Sugar-Cane CCI	5 Fodder CCI	6 Pulses CCI	7 Oil Seed CCI	8 Orchard CCI	9 Vegetable CCI
Rawalpindi	0.63	1.39	n.	n.	n.	n.	n.	4.4	n.	n.
Attock	0.60	1.45	n.	n.	n.	n.	n.	10.1	n.	1.8
Jhelum	0.61	1.45	n.	n.	n.	n.	n.	1.3	n.	8.0
Chakwal	0.64	1.28	n.	n.	n.	n.	n.	15.4	n.	n.
Gujranwala	0.60	1.06	3.13	n.	n.	n.	n.	n.	n.	n.
Hafizabad	0.62	1.04	3.12	n.	n.	n.	n.	n.	n.	n.
Gujrat	0.64	1.22	1.21	n.	n.	n.	n.	n.	n.	n.
Mandi Bahauddin	0.71	0.86	2.22	n.	1.14	2.5	n.	n.	n.	n.
Sialkot	0.60	1.04	4.29	n.	n.	n.	n.	n.	n.	n.
Narowal	0.62	0.65	2.89	n.	n.	n.	n.	n.	n.	n.
Lahore	0.68	0.95	2.5	n.	n.	n.	n.	n.	n.	n.
Kasur	0.76	0.93	1.47	n.	1.4	1.9	n.	n.	n.	3.2
Okara	0.77	0.9	1.65	0.5	0.6	n.	n.	n.	n.	10.3
Sheikhupura	0.58	1.08	3.17	n.	n.	n.	n.	n.	n.	n.
Nankanasahib	0.68	1.02	2.4	n.	0.8	n.	n.	0.8	n.	n.
Faisalabad	0.74	1.03	0.8	0.3	4.6	n.	n.	n.	n.	n.
Toba Tek Singh	0.75	1.03	0.86	0.96	1.3	n.	n.	n.	n.	1.4

n. : Negligible

District	Crop Diver. Index CDI	1 Wheat CCI	2 Rice CCI	3 Cotton CCI	4 Sugar-Cane CCI	5 Fodder CCI	6 Pulses CCI	7 Oil Seed CCI	8 Orchard CCI	9 Veget able CCI
Jhang	0.74	1.04	1.37	0.64	1.8	n.	0.81	n.	n.	n.
Chinot	0.76	0.91	1.07	n.	1.5	n.	n.	n.	n.	n.
Sargodha	0.78	0.85	1.0	n.	1.97	n.	n.	0.66	n.	n.
Khushab	0.73	0.67	0.51	n.	0.89	n.	6.8	n.	n.	n.
Mianwali	0.64	1.32	n.	n.	n.	n.	3.3	n.	n.	n.
Bhakkar	0.67	0.57	n.	0.53	0.76	n.	8.1	n.	n.	n.
Multan	0.69	0.9	0.3	2.3	n.	n.	n.	n.	n.	n.
Lodhran	0.61	1.0	n.	3.0	n.	n.	n.	n.	n.	n.
Vehari	0.69	1.0	0.5	2.2	0.41	n.	n.	n.	n.	n.
Sahiwal	0.77	0.9	0.9	1.26	0.26	n.	n.	n.	n.	4.3
PakPatan	0.77	0.86	1.63	0.8	n.	n.	n.	n.	n.	6.7
Khanewal	0.71	0.74	0.63	2.06	0.27	n.	n.	n.	n.	1.4
Dera Ghazi Khan	0.68	1.14	0.64	1.82	0.41	n.	n.	n.	n.	n.
Rajanpur	0.61	0.9	n.	3.0	0.28	n.	n.	n.	n.	n.
Leiah	0.71	0.88	n.	0.6	0.6	n.	6.6	n.	n.	n.
Muzaffargarh	0.71	1.0	0.63	2.1	1.42	n.	n.	n.	n.	n.
Bahawalpur	0.64	1.0	n.	2.8	0.6	n.	n.	n.	n.	n.
Bahawalnagar	0.70	1.0	0.57	2.2	0.58	n.	n.	n.	n.	n.
Rahimyar Khan	0.71	0.98	0.2	2.4	3.0	n.	n.	n.	n.	n.

**Source:** Pakistan Agriculture Census and Crops statistics yearbook, 2021 ,  
 CDI and CCI values are calculated by authors.

**Table-3**  
**Main, secondary and minor cropping regions of important crops in Punjab**

Crops	Main region	Secondary region	Minor region
Wheat	Rahimyarkhan, Bahawalnagar Bahawalpur, D.G.Khan, Muzaffarkhar, Sarghodha, Faisalabad, Jhang, Bhakkar, Gujranwala	Okara, Kasur, Vehari, Khanewal, Mianwali, Rajanpur, Leiah Nankanshib, Sialkot, Attock, Pakpattan	Lahore, Rawalpindi Jhelum, Chakwal, Gujrat, Hafizabad, Narowal Mandibahauddin, Chiniot, Sheikhupura, T.T.Singh, Khushab, Multan, Lodhran
Rice	Gujranwala, Sialkot	Okara, Nankanasahib Sheikhupura, Hafizabad Jhang, Kasur, Sarghoda Narowal, Pakpattan Lahore, Muzaffargarh Faisalabad	Bahawalnagar, D.G Khan, Sahiwal, Chiniot, Khanwal T.T.Singh, Gujrat, Vehari, Khushab,
Cotton	Rahimyarkhan, Bahawalnagar, Muzaffargarh Bahawalpur	Multan, Lodhran, Vehari, Khanewal, D.G.Khan, Rajanpur	Bhakkar, Sahiwal, Leiah, Pakpattan, Jhang, Okara, T.T. Singh
Sugarcane	Faisalabad, Rahimyarkhan, Sargodha, Jhang Muzaffargarh	Chiniot, T.T.Singh Kasur, Bhakkar, Leiah, Khushab, Okara, Nankanasahib	Vehari, D.G.Khan, Sahiwal, Khanewal, Rajanpur, Bahawalnagar, Bahawalpur
Maize	Okara, Sahiwal, Pakpattan	Kasur, Nankanasahib T.T.Singh,	Faisalabad, Chiniot, Sargodha, Vehari, Bhakkar
Oil Seed	Chakwal, Attock	Jhelum, Rawalpindi. Sarghodha, Faisalabad Bahawalnagar, Bahawalpur, Rahimyarkhan	Kasur, Okara, Jhang Nankanasahib, Khushab, Bhakkar, Vihari, Leiah, Rajanpur, Okara, Kasur, Nankanasahib
Pulses	Bhakkar	Leiah, Khushab Mianwali	Jhang, Bahawalnagar, Chakwal
Vegetable (Potatoe)	Okara	Pakpattan, Sahiwal, Kasur	Khanewal, Attock, Jhelum,
Orchards	Sargodha	Multan, Rahimyarkhan, Muzaffargarh	Mandibahauddin, Leiah, Sahiwal, T.T.Singh Khanewal, Bahawalpur
Fodder	Sargodha	Kasur, Bhakkar, Bahawalnagar, Jhang Faisalabad	Okara, Chiniot, Muzaffargarh, Pakpattan, Sahiwal, D.G. Khan

**Source:** Pakistan Agriculture Census and Crops Statistics Yearbook, 2021

Table-4  
Crops Combination Regions in Punjab Province

District	1 Dominated Crops Region	2 Weaver's Crops Combination Regions	3 Thomas' Crops Combination Regions
<b>2 CROPS REGIONS</b>			
Stalkot	Wheat-Rice	Wheat-Rice	Wheat-Rice-Fodder
Gujranwala	Wheat-Rice	Wheat-Rice	Wheat-Rice-Fodder
Hafizabad	Wheat-Rice	Wheat-Rice	Wheat-Rice-Fodder
Sheikhpura	Wheat-Rice	Wheat-Rice	Wheat-Rice-Fodder
Rajanpur	Wheat-Cotton	Wheat-Cotton	Wheat-Cotton
Bahawalpur	Wheat-Cotton	Wheat-Cotton	Wheat-Cotton-Fodder
Lodhran	Cotton-Wheat	Cotton-Wheat	Cotton-Wheat-Fodder
<b>3 CROPS REGIONS</b>			
Gujrat	Wheat	Wheat-Rice-Fodder	Wheat-Rice-Fodder-Bajra
Mandi Bahauddin	Wheat-Rice	Wheat-Rice-Fodder	Wheat-Rice-Fodder
Narowal	Wheat-Rice	Wheat-Rice-Fodder	Wheat-Rice-Fodder
Lahore	Wheat-Rice	Wheat-Rice-Fodder	Wheat-Rice-Fodder
Kasur	Wheat	Wheat-Rice-Fodder	Wheat-Rice-Fodder
Jhang	Wheat	Wheat-Rice-Fodder	Wheat-Rice-Fodder-Cotton
Nankanasahib	Wheat	Wheat-Rice-Fodder	Wheat-Rice-Fodder
Multan	Wheat	Wheat-Cotton-Fodder	Wheat-Cotton-Fodder
Vehari	Wheat	Wheat-Cotton-Fodder	Wheat-Cotton-Fodder-Rice
Bahawalnagar	Wheat	Wheat-Cotton-Fodder	Wheat-Cotton-Fodder-Rice
Khanewal	Wheat	Wheat-Cotton-Fodder	Wheat-Cotton-Fodder-Rice
Muzaffargarh	Wheat	Wheat-Cotton-Rice	Wheat-Cotton-Rice-Fodder
Rahimyar Khan	Wheat	Wheat-Cotton-Sugarcane	Wheat-Cotton-Sugarcane-Fodder
<b>4 CROPS REGION</b>			
Faisalabad	Wheat	Wheat-Sugarcane-Fodder	Wheat-Sugarcane-Fodder-Rice
Mianwali	Wheat	Wheat-Pulses-Cotton	Wheat-Pulses-Cotton
Khushab	Pulses	Pulses-Wheat-Fodder	Pulses-Wheat-Fodder-Rice
Bhakkar	Pulses	Pulses-Wheat-Fodder	Pulses-Wheat-Fodder-Cotton
Leiah	Pulses-Wheat	Pulses-Wheat-Cotton	Pulses-Wheat-Cotton
Attock	Wheat	Wheat-oil seed- Maize	Wheat-oil seed- Maize-Fodder
Chakwal	Wheat	Wheat-oil seed-Fodder	Wheat-oil seed-Fodder
Jhelum	Wheat	Wheat-Bajra-Maize	Wheat-Bajra - Maize-Vegetable
Rawalpindi	Wheat	Wheat-Maize-Fodder-oil seed	Wheat-Maize-Fodder-oil seed
Okara	Wheat	Wheat-Rice-Fodder-Cotton	Wheat-Rice-Fodder-Cotton- Vegetable
Toba Tek Singh	Wheat	Wheat-Cotton-Rice-Fodder	Wheat-Cotton-Rice-Fodder-Sugarcane
Chinot	Wheat	Wheat-Fodder-Rice-Sugarcane	Wheat-Fodder-Rice-Sugarcane
Sargodha	Wheat	Wheat-Fodder-Rice-Orchard	Wheat-Fodder-Rice-Orchard
Sahiwal	Wheat	Wheat-Cotton-Fodder-Rice	Wheat-Cotton-Fodder-Rice
PakPatan	Wheat	Wheat-Rice-Fodder-Cotton	Wheat-Rice-Fodder-Cotton
Dera Ghazi Khan	Wheat	Wheat-Cotton-Fodder-Rice	Wheat-Cotton-Fodder-Rice

Source Pakistan Agriculture Census and Crops Statistics Yearbook, 2021. The regions are determined on the basis of calculation of Weaver and Thomas models, computed by the authors.

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