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A Study of Crop Combination Regions in Chitrakoot District, U.P.

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ABSTRACT

A concept of growing different types of crops under the same field at a given point of time is known as crop combination for agriculture regionalization the study of crop combination is very important. For planning and development of agriculture this technique is very important. The present study is focused on the crop combinations regions that are identified for year 2011-12 and 2021-22 for clear and extensive understanding of the changing cropping pattern in Chitrakoot District U.P. Weaver's method is used for the delineation of agriculture region of Chitrakoot Disrict(U.P.). 5 to 8 crop combinations are found in the study area.

Introduction:

The study of crop combinations regions constitute an important aspect of agriculture geography as it provides a basis for agricultural regionalization. In recent years the concept of crop combinations has engaged the attention of geographers and agricultural land use planners. The studies made so far in this field range in approach from tropical to regional and vary in extent from small areas of minor political units to the entire country. (Hussain Majid 1979, pp-120,121). It helps in understanding the cropping pattern of region. The study of crop combination thus forms and integral part of agriculture geography and such study is significantly helpful for regional agriculture planning (Singh and Gupta, 2020). In the study area more than 90% of population lived in rural area and totally dependent on agriculture. So there

is an urgent need to identify the combination of crop grown in the study area for the betterment of the people.

Study area:This paper studies the identification of crop combination region of Chitrakoot district. The study area lies between 24° 53 N to 25° 33 N latitude and 80°41'E to 81°34 E longitude and covers an area of 3205.95 km^2. Administratively the district comprises the two tehsils namely Kawri and Mau and five development blocks Pahari, Kawri, Manikpur, Ramnagar, Mau. Like other districts of Bundelkhand region Chitrakoot experience extremities in climatic condition during summer and winter. The average annual rainfall for the district amount to 800 to 950 mm, about 88% of the total annual rainfall is concentrated in the rainy season (from June to September). Average annual temperature is 33°C. Agriculture is the backbone of the economy of Chitrakoot district. The district is very rich in terms of resources like land, minerals, forests etc. but it is one of the backward district in the state. The gross cropped area of Chitrakoot was 189633 in 2011-12 and 221936 in 2021-22.

Literature Review

Crop-combination analysis is a well-established approach in agricultural geography for understanding the spatial structure of agriculture and for identifying agricultural regions based on the association and dominance of crops. The concept gained prominence with the shift of geography from descriptive regional studies to analytical and quantitative approaches in the mid-twentieth century. Crop combinations reflect not only physical environmental conditions but also socio-economic organization, technological development, cultural traditions, and farmers' adaptive strategies.

The earliest systematic and quantitative contribution to crop-combination analysis was made by **J. C. Weaver (1954)**, who proposed the minimum deviation method for identifying crop-combination regions. Weaver's approach provided a scientific basis for agricultural regionalization by comparing actual crop percentages with ideal theoretical distributions. His study of the Middle West (USA) demonstrated that agricultural landscapes could be meaningfully classified into mono-crop and multi-crop regions. Weaver's method became a milestone in agricultural geography and continues to be widely applied due to its objectivity and comparative strength.Before Weaver, early ideas related to crop association and agricultural regions were indirectly discussed by scholars such as **O. E. Baker (1926)**, who emphasized crop statistics and agricultural specialization in regional studies. Baker's work laid the foundation for later quantitative analysis of agricultural land use. Similarly, **Derwent Whittlesey (1936)**, in his concept

of agricultural regions, highlighted the importance of crop combinations, livestock association, and farming systems as defining characteristics of agricultural landscapes.

In India, crop-combination studies developed rapidly with the expansion of agricultural geography as a specialized branch of human geography. **Majid Husain (1979)** provided a comprehensive discussion on crop combinations, emphasizing that they are shaped by a complex interaction of climatic conditions, soil characteristics, irrigation availability, farm size, and socio-economic constraints. According to Husain, high crop combinations are typical of subsistence-oriented and monsoon-dependent regions, while low combinations are generally found in irrigated and commercialized agricultural areas.The contribution of **R. L. Singh (1971)** further strengthened the theoretical base of agricultural regionalization in India. Singh emphasized that agricultural regions should be delineated using a combination of crop patterns, land-use intensity, and socio-economic variables. He argued that crop combinations are dynamic in nature and change with technological advancement, population pressure, and market integration.Several Indian scholars have empirically applied Weaver's method at different spatial scales. **S. S. Bhatia (1965)** analyzed agricultural regions of India and observed that diversification of crops is closely linked with rainfall variability and soil conditions. His work highlighted that regions prone to drought and climatic uncertainty tend to exhibit higher crop combinations as a risk-management strategy.Later studies by **Singh and Dhillon (2004)** emphasized that crop combination and crop diversification are not merely physical responses but also socio-economic decisions influenced by accessibility to irrigation, credit, and markets. Similarly, **Singh and Gupta (2020)** pointed out that crop-combination analysis plays a vital role in regional planning by identifying dominant crops and associated cropping systems that require targeted policy support.

Recent micro- and meso-level studies demonstrate the importance of spatio-temporal analysis in understanding changes in crop combinations. **Mane (2019)** observed that the emergence of new crop combinations over time reflects technological diffusion, policy incentives, and changing farmer preferences. **Jana (2022)** showed that district-level crop-combination regions undergo continuous transformation due to climate variability, irrigation expansion, and shifts in minimum support prices.

In drought-prone regions such as **Bundelkhand**, agricultural diversification is widely recognized as an adaptive response to environmental stress. Studies on rainfed agriculture by **M. S. Swaminathan** emphasized the role of crop diversification, pulses, and oilseeds in ensuring sustainability, nutritional security, and resilience against climate shocks. However, despite Bundelkhand's importance as a problem region, detailed block-level crop-combination studies remain limited.

Against this backdrop, the present study of **Chitrakoot District** assumes significance. By applying Weaver's method for two time periods (2011–12 and 2021–22), the study contributes to the understanding of spatio-temporal changes in crop combinations in a climatically fragile, socio-economically backward region. The findings are expected to support agricultural planning, risk mitigation, and sustainable development strategies in the district.

Objectives:

1. To understand the copping pattern of various blocks in Chitrakoot district.
2. To analyse the spatio-temporal changes of crop combination during the period 2011-12 to 2021-22.

Database and Methodology:

The present study is based on the data (secondary) acquired from the district statistical handbook of Chitrakoot District for the year 2011-12 and 2021-22. Weavers Method (1954) is used to calculate the crop combination. In the study area crop combinations have been computed on the basis of deviation of the real percentage of crops for all the possible combinations in the component areal units against theoretical standard.

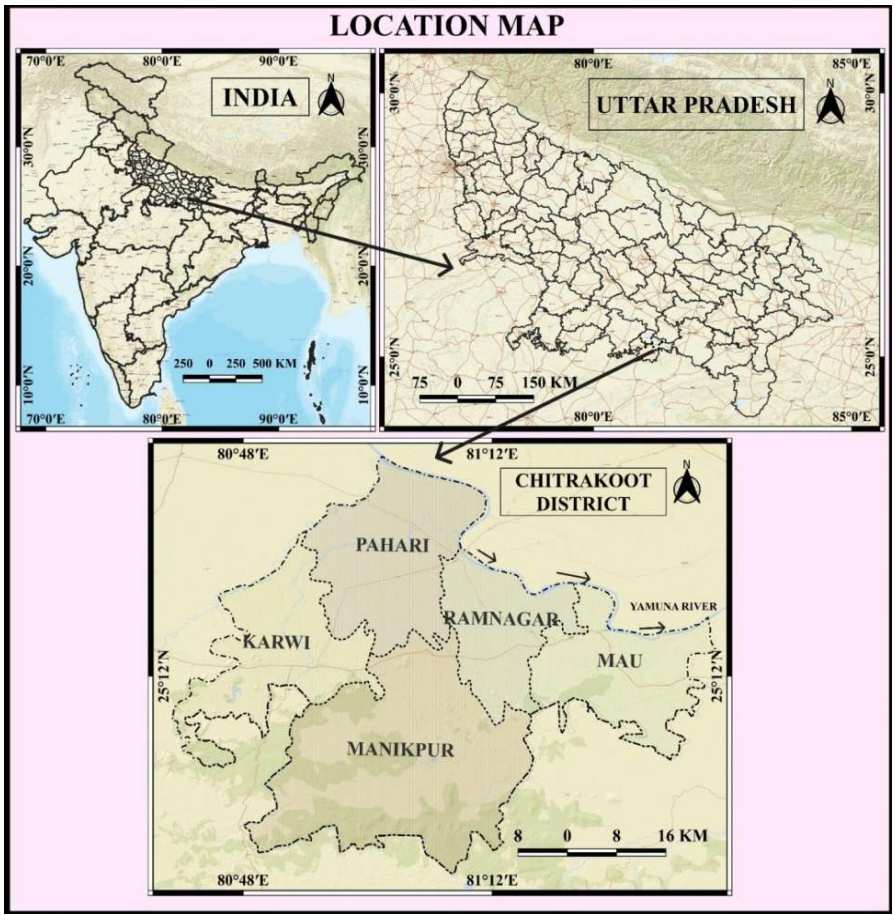

Fig-1

Chropleth maps for different crop combination regions is prepared by using QGIS software.

Result and Discussion:

Crop combination is a concept of growing different types of crops under a same field. In the present study statistical method of John C. Weaver is used for analysing crop combination. In the method of J.C. Weaver deviation of the real percentage of crops for all the possible combination in the component areal unit against a theoretical standard has been calculated. Weaver used standard deviation formula for arriving at most dominant crop combination.

Which is as follows-

S.D. = $\sqrt{\sum d^2/n}$

Where, d = $\bar{X}$−X

d represents deviation from ideal area

X represents area under a crop in a year

$\bar{X}$ represents ideal area

n represents number of crops.

The theoretical curve for the standard measurement was employed as follows:

Monoculture = 100% of the total harvested crop land in one crop.

2 Crop combination = 50% in each of two crops

3 Crop combination = 33.3% in each of three crops

4 Crop combination = 25% in each of four crops

5 Crop combination = 20% in each of five crops systematically through to 8 Crop combination = 12.5% in each of eight crops.

As Weaver pointed out, the relation, not absolute value being significant square roots were not extracted so, the actual formula used was as follows;

d = d^2/n

The present study is focused on the 5 blocks of Chitrakoot district U.P.

Table No-1: Percentage of Cropped Area to Gross Cropped Area of the District (2011-12)

Sr. No.	Block	Rice	Wheat	Sourghum	Red lentil	Gram	Pigion Pea	Oil seeds	Barley
1	Pahari	4.31	20.19	6.86	15.72	26.48	4.27	1.56	1.75
2	karwi	5.98	26.92	8.73	7.30	22.23	7.95	1.86	1.52
3	Manikpur	5.32	31.11	10.46	2.10	15.54	10.19	4.86	2.66
4	Ramnagar	2.66	15.12	9.27	12.44	20.34	9.45	1.30	3.41
5	Mau	4.26	16.35	10.07	9.69	18.10	15.83	1.00	3.39
	Total	4.70	22.87	8.88	9.45	21.06	8.84	2.20	2.36

Source: Calculated and Compiled by the author using data from district statistical Handbook, 2011-12

Table No-2: Percentage of Cropped Area to Gross Cropped Area of the District (2021-22)

Source: Calculated and Compiled by the author using data from district statistical Handbook, 2021-22

Sr. No.	Block	Rice	Wheat	Sourghum	Red lentil	Gram	Pigion Pea	Oil seeds	Barley
1-	Pahari	4.31	22.95	7.47	17.53	27.60	7.23	2.93	1.93
2-	karwi	5.57	29.05	12.44	6.21	25.95	8.91	3.66	1.94
3-	Manikpur	8.46	30.56	10.13	5.33	20.25	8.07	5.33	4.18
4-	Ramnagar	2.52	20.89	9.87	13.31	25.82	10.44	3.29	3.81
5-	Mau	4.43	26.40	6.43	6.94	21.05	10.89	2.83	3.75
	Total	5.27	26.33	9.52	10.04	24.54	8.77	3.89	2.88

Table -3: Delineation of crop combination regions of Chitrakoot District U.P. for the year 2011-12 and 2021-22

Sl. no	Block	Values	Crop Combinatio	Types of crops	Values	Crop Combination	Types of

			n				crops
		2011-12			**2021-22**		
1	Pahari	78.50	5 crops	G,W,RL,Sg ,PP	85.37	6 crops	G,W,R L,Sh,R ,PP
2	Karwi	91.48	7 crops	W,G,SG,PP ,RL,R,OS	79.50	6 crops	W,G,S G,PP,R L,R
3	Manikpur	74.96	8 crops	W,G,SG,R, PP,RL,OS, B	84.98	8 crops	W,G,S G,PP,R ,OS,B, RL
4	Ramnagar	54.67	5 crops	G,W,RL,PP ,Sg	48.97	7 crops	G,W,R L,PP,S, B,R
5	Mau	71.50	8 crops	W,G,PP,RL ,SG,R,B,O S	39.89	7 crops	G,W,P P,RL,R ,B
	Total	72.97	7 crops	W,G,RL,S, PP,R,OS	60.81	8 crops	W,G,R L,S,PP, R,B,O S

Source: Calculated and compiled by the author based on Weaver's Method

R = Rice, W= Wheat, S= Sourghum, R= Red lentil, g= gram, Pp= Pigeon pea, Os= oil seeds, B= Barley

Table No-4: Crop combination Pattern in Chitrakoot District U.P. for the year 2011-12 and 2021-22

Sl. No.	No of crops	No of Blocks	Name of Blocks	No of Block	Name of Blocks
		2011-12		2021-22	
1	Monoculture	0	-	0	-
2	2 crops	0	-	0	-
3	3 crops	0	-	0	-
4	4 crops	0	-	0	-
5	5 crops	02	Pahari, Ramnagar	0	-
6	6 crops	0	-	02	Pahari, Karwi
7	7 crops	01	Karwi	02	Ramnagae, Mau
8	8 crops	02	Manikpur, Mau	01	Manikpur

Source: Calculated and compiled by the author based on Weaver's Method

Five crop combination

In 2011-12 five crop combinations were seen in two blocks (Pahari and Ramnagar) of Chitrakoot District(table-4). In the same year gram is dominant crop followed by the wheat, red lentil, sourghum and pigeon pea in Pahari block. These five crops have 82.78% area of total gross cropped area in this block. If we see the situation of Ramnagar block here also gram is dominant crop followed by the same crops as Pahari block. In Ramnagar block the above five crops captured the 80.33% area of gross cropped area. Five crop combination is not found in any block of Chitrakoot in the year 2021-22.

Six crop combinations

In 2011-12 six crop combination was not found in any block of the district. It is only found in the year 2021-22 in Pahari and Karwi block(table-4).if In Pahari 6 most important crops were gram (26.48%), wheat (20.19%), red lintel (15.72%), sourghum (6.86%), rice (4.81%) and pigeon pea (4.27%). In Karwi block wheat was dominant with the share of 26.92% area of gross cropped area followed by gram (22.23%), sourgham (8.73%), pigeon pea (7.95%), red lentil (7.30%), rice (5.98%)(table-2).

Seven crop combination

As it is shown in table-4 that in the year 2011-12 seven crop combination is found only in one block Karwi. In this block highest percentage of crop is wheat (29.05%) followed by gram (25.95%), sourgham (12.44%), pigeon pea (8.91%) etc(table-1). In this block soil variety like alluvial, black and red are suitable for a wide range of crops.

If we see the pattern of Crop combination in the year 2021-22 we found that seven crop combination is exists in Ramnagar and Mau block. In Ramnagar block important crops were gram (20.34%) wheat (15.12%), red lintel (12.44%), pigeon pea (9.45%), sourgram (9.27%), Barley (3.41%) and rice (2.66%) these seven crops share 72.69% of total gross cropped area(table-2).

Eight crop combination

In the year 2011-12 eight crop combination was found in Manikpur and Mau blocks of the district. The Manikpur and Man blocks of Chitrakoot district exhibit an eight-crop combination due to a combination of geographical, climatic, socio-economic and agricultural factors. These blocks contain both plateau and plain regions allowing for diverse cropping patterns suited to different land types. In the same period in both the blocks wheat is dominated crop having 30.56% (Manikpur) and 26.40% (Mau) of gross cropped area followed by gram, sougham, rice, pigeon pea, red lentil, oil seeds and barley(table-1).

If we see the data of 2021-22, we found that only one block which is Manikpur falls under this category with wheat dominated area (31.11%). The others crop of the area are gram, sourgham, pigeon pea, rice, oil seeds, barley and red lentil(table-2). It is observed that Manikpur area that depend upon rainfall as well as pockets with irrigation (wells, tank, canals) enabling cultivation of multiple crops across season.

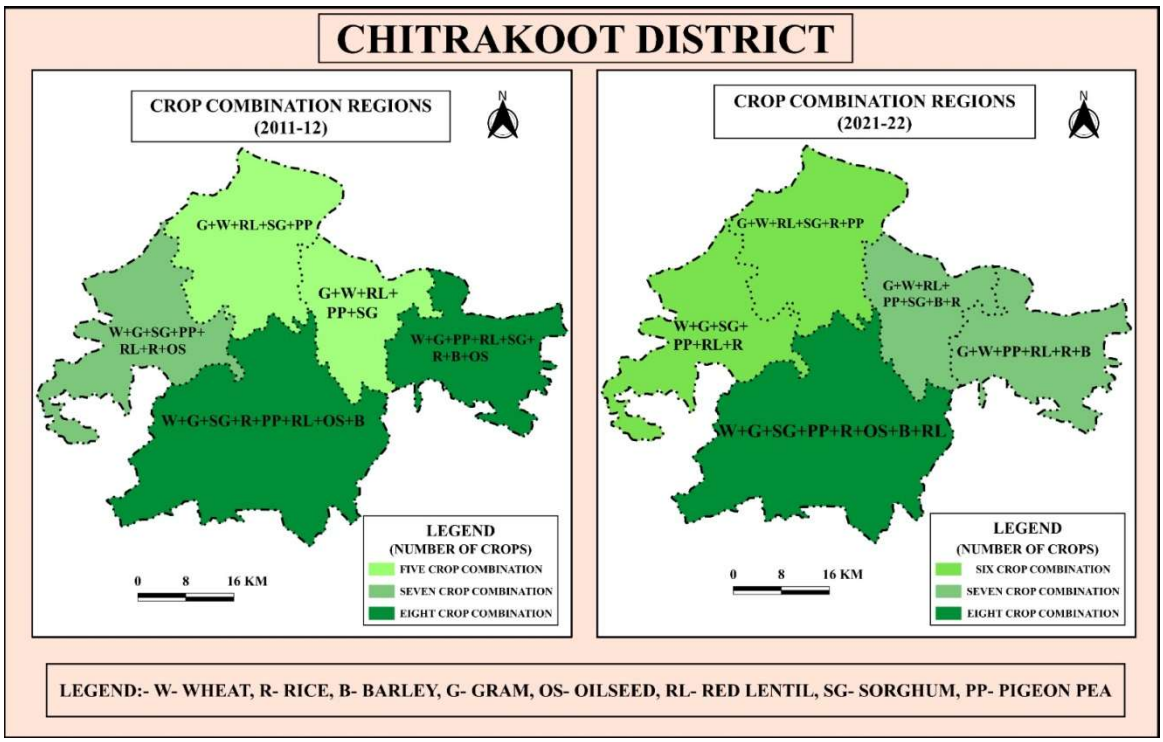

Fig-2

Critical analysis of crop combination regions in Chitrakoot District U.P.

Crop combination in Chitrakoot District represents an adaptive agricultural response shaped largely by environmental constraints, socio-economic compulsions, and traditional farming practices rather than by commercial intensification. The widespread practice of growing multiple crops simultaneously reflects farmers' efforts to cope with climatic uncertainty, limited irrigation, and fragile resource conditions. The district's varied physical setting, comprising plains and plateau surfaces, creates micro-climatic diversity that permits the cultivation of cereals, pulses, oilseeds, and fodder crops within the same agricultural year. However, this diversity is closely associated with erratic monsoon rainfall and frequent drought conditions, making crop combination more of a risk-management strategy than a means of maximizing productivity.

The presence of different soil types such as alluvial, black, and red soils supports diversified cropping, yet soil fertility is uneven and often degraded due to erosion, shallow soil depth in plateau areas, and low organic matter. Under such conditions, mixed cropping helps in maintaining soil nutrients and reducing land degradation, but the absence of scientific soil management and limited access to modern inputs restrict overall yields. Consequently, crop combinations tend to remain subsistence-oriented with low productivity and limited surplus.

Socio-economic factors further reinforce the dominance of crop combinations. Small and fragmented landholdings compel farmers to cultivate multiple crops on the same land to ensure household food security and income stability. Traditional mixed farming practices, deeply rooted in local knowledge, help reduce the risk of complete crop failure due to pests, diseases, or rainfall variability. At the same time, these practices often limit specialization and mechanization, thereby constraining agricultural growth and farmers' participation in wider markets.

Limited irrigation facilities, mainly dependent on wells, tanks, and small canals, also play a decisive role in shaping crop combinations. The uncertainty of water availability discourages the cultivation of water-intensive or high-value crops and encourages the inclusion of drought-resistant varieties within the cropping system. While this enhances resilience, it also perpetuates low levels of investment and technological adoption in agriculture.

Government initiatives promoting crop diversification and providing subsidies have contributed to the continuation of mixed cropping practices, but their impact remains uneven due to inadequate implementation, lack of awareness, and weak market linkages. As a result, crop combination in Chitrakoot largely functions as a survival-oriented strategy rather than a carefully planned development approach. Overall, crop combination regions in the district reflect both the adaptive capacity of farmers and the structural limitations of the agrarian system. Without improvements in irrigation, soil management, extension services, and market support, crop combinations will continue to provide stability and risk reduction but only limited scope for sustainable agricultural growth.

Conclusion

The crop combination regions of Chitrakoot District reflect the district's ecological constraints and socio-economic realities, where undulating terrain, shallow soils and erratic rainfall have made rainfed, risk-minimizing agriculture dominant. Farmers adopt combinations of drought-tolerant cereals (sorghum, bajra, maize), pulses (arhar, gram, moong) and oilseeds (groundnut, mustard, til), while in low-lying irrigated pockets rice–wheat and vegetable-based systems prevail, ensuring both subsistence and marketable surplus. Legume-based combinations enhance soil fertility through nitrogen fixation, support crop rotation, and reduce pest incidence, thereby improving sustainability. Such diversified systems provide food, income and nutritional security, yet challenges of small fragmented holdings, low irrigation coverage, poor access to improved seeds and weak marketing infrastructure persist. Future agricultural development in Chitrakoot requires expansion of irrigation through farm ponds, check dams and micro-

irrigation, coupled with the promotion of horticulture, agroforestry and medicinal crops, alongside policy support in credit, insurance, MSP and market linkages. Thus, crop combinations here are not accidental but adaptive strategies for stability, resilience and long-term sustainability of agriculture in Bundelkhand's challenging environment.

References

- Baker, O. E. (1926). *Agricultural regions of North America*. U.S. Department of Agriculture.
- Bhatia, S. S. (1965). Patterns of crop concentration and diversification in India. *Economic Geography*, 41(1), 39–56.
- Husain, M. (1979). *Agricultural Geography*. New Delhi: Inter-India Publications.
- Jana, R. (2022). Crop combination regions and agricultural regionalization: A spatio-temporal analysis using Weaver's method. *International Journal of Creative Research Thoughts (IJCRT)*, 10(3), 245–252.
- Mane, S. B. (2019). Crop combination analysis based on Weaver's method: A micro-level study. *International Journal of Geography and Geology*, 8(2), 18–25.
- Parihar, S. S. (2018). Crop combination and crop diversification in north-western India. *International Archive of Applied Sciences and Technology*, 9(1), 6–12.
- Singh, R. L. (1971). *India: A regional geography*. New Delhi: National Geographical Society of India.
- Singh, R., & Dhillon, S. S. (2004). *Agricultural geography*. New Delhi: Tata McGraw-Hill.
- Singh, R., & Gupta, K. (2020). Agricultural regionalization and cropping pattern analysis in India. *Indian Journal of Spatial Science*, 11(2), 45–57.
- Swaminathan, M. S. (2006). *Sustainable agriculture and food security*. Chennai: MSSRF.
- Weaver, J. C. (1954). Crop-combination regions in the Middle West. *Geographical Review*, 44(2), 175–200. https://doi.org/10.2307/212355
- Whittlesey, D. (1936). Major agricultural regions of the Earth. *Annals of the Association of American Geographers*, 26(4), 199–240.