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An Analytical Study of the Factors Affecting the Crop Pattern in India

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Abstract *— Actually, a cropping pattern of any geographical area is keenly associated with its land use pattern, which is the arrangement and distribution of total cultivated land for different purposes such as forestation, cropping, human settlement etc. Late 2024, the total area covered by the 'rabi crops' in India indicated a significant contribution to wheat, pulses and oilseeds reaching 428 lakh hectares in which wheat cropping covered 320 lakh hectares; it was an increase of 1.38 lakh hectares when compared to the past year. On the contrary, the rice cropping area increased to 394.28 lakh hectares which was 378.04 lakh hectares in the previous years. Meanwhile, the whole cropping area in India was recorded at 1114.95 lakh hectares including all crops during 2023-24 with an increase of 6.51 lakh hectares when compared to the past years. As per statistical data received from a report by the Agriculture Ministry of India, in the years 2024-25, there is a remarkable change in cropping pattern in India. In the recent years, India has become the world's top most or largest producer country of a range of agricultural products; dry fruits, raw materials for textiles, root and tuber crops, pulses, fish raised on farms, eggs, coconuts, sugarcane, and vegetables of various kinds, among many others. For the fiscal year ending June 2024 with a normal monsoon, Indian agriculture recorded production of wheat and rice as major crops recording a boost in the production. Meanwhile, lentils and other major food staples also saw a noticeable increase during this time. However, crop output in India is affected by a number of variables that have become quite predictable such as: the performance of the monsoon, the farm size, the input supply, and the accompanying government agricultural policies. As we know, three monsoon cropping seasons are widely recognized in India as: Kharif, Rabi and Zaid, which can be described as cropping seasons defined by climate. The Kharif cropping season occurs at the same time as the South-west monsoon and is particularly advantageous to tropical crops such as rice, cotton, jute, bajra, etc. The Rabi cropping season starts about October–November and progresses to the spring months, while Zaid is a short summer season following the Rabi harvest. The present research paper makes an analysis of cropping patterns and factors affecting it from 2015 to 2025. Moreover, this research is exploratory in nature and based on the secondary sources of data collection from different articles published in reputed journals, reference books and statistical reports of the Ministry of Agriculture, Economic Survey etc. To pace the study, the researcher has also used some observational insights.*

Keywords *— **agricultural production, farming, plantation, crop pattern, mix Cropping, kharif crops, rabi crops.***

I. INTRODUCTION

It is a well-known fact that India is the second largest producer of rice and wheat in the world. According to the statistical data derived from the Food and Agriculture Report-2024, India is also the largest producer in the world of fresh fruits, vegetables, fibrous crops like jute, and staple crops like millets and castor oil seeds. In 2013, India exported agricultural products worth approximately $39 billion which has reached $51.9 billion in the financial year 2024-25. The recent expansion of irrigation

infrastructure has further strengthened India's food security, lessened dependence on monsoons, increased productivity, and created rural employment. According to the 2011 Census, India had the world's largest gross irrigated crop area—82.6 million hectares which has seen a remarkable growth in recent years. As a result, India ranks among the top three producers in the world of wheat, rice, pulses, cotton, peanuts, fruits, and vegetables.

II. PRODUCTION COST OF MAJOR CROPS

India has the ability to raise agricultural productivity of all major crops and income, harnessing technology and infrastructure. The table-1 presents the projected cost of all agricultural products and major crops-kharif, rabi and other crops grown in India from 2017-18 to 2024-25. Likewise, crop-wise covered area has been shown in million hectares in table-2.

Table:1- Production Cost of Major Crops from 2017-18 to 2024-25.

Sr. No.	Commodity	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
(A) Kharif Crops-									
1	Paddy	1117	1166	1208	1245	1293	1360	1455	1533
2	Jowar	1556	1619	1698	1746	1825	1977	2120	2247
3	Bajra	949	990	1083	1175	1213	1268	1371	1485
4	Ragi	1861	1931	2100	2194	2251	2385	2564	2860
5	Maize	1044	1131	1171	1213	1246	1308	1394	1447
6	Arhar(Tur)	3318	3432	3636	3796	3886	4131	4444	4761
7	Moong	4286	4650	4699	4797	4850	5167	5705	5788
8	Urad	3265	3438	3477	3660	3816	4155	4592	4883
9	Cotton	3276	3433	3501	3676	3817	4053	4411	4747
10	Groundnut In Shell	3159	3260	3394	3515	3699	3873	4251	4522
11	Sunflower Seed	3481	3592	3767	3921	4010	4113	4505	4853
12	Soybean	2121	2266	2473	2587	2633	2805	3029	3261
13	Sesamum	4067	4166	4322	4570	4871	5220	5755	6178
14	Nigerseed	3912	3918	3960	4462	4620	4858	5156	5811
(B) Rabi Crops-									
1	Wheat	817	866	923	960	1008	1065	1128	1182
2	Barley	845	860	919	971	1019	1082	1158	1239
3	Gram	2461	2637	2801	2866	3004	3206	3400	3527
4	Masur (Lentil)	2366	2532	2727	2864	3079	3239	3405	3537
5	Rapeseed & Mustard	2123	2212	2323	2415	2523	2670	2855	3011
6	Safflower	3125	3294	3470	3551	3627	3765	3807	3960
(C) Other Crops-									
1	Copra	5007	6347	6639	6805	6974	7153	7350	

2	Jute	2160	2267	2535	2709	2832	2959	3095	3237
3	Sugarcane	145	155	156	159	155	162	157	164

(**Source**: Agricultural Statistics at a Glance, Ministry of Agriculture, GOI, New Delhi, 2025.)

Note: Production cost is as per quintal.

Table:2-Major Crops-wise Covered Area from 2015-16 to 2023-24 in Million Hectares.

Commodity	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**	**2022-23**	**2023-24***
Total Foodgrains	129.47	137.56	137.50	137.70	138.41	140.11	141.00	140.73	140.69
Rice	43.99	43.77	44.16	43.66	45.77	46.28	47.83	47.83	51.27
Wheat	30.79	29.65	29.32	31.36	31.13	30.46	31.40	31.83	32.80
Total Pulses	24.66	29.41	24.88	25.58	24.31	24.82	27.81	27.50	27.34
Total Oilseeds	26.09	28.11	25.89	24.71	24.77	28.51	28.79	29.66	29.33
Sugarcane	4.93	4.41	5.06	5.23	5.23	4.85	5.42	5.60	5.56
Cotton	12.29	10.51	12.44	12.74	13.47	12.96	12.82	12.72	12.57
Jute & Mesta	0.75	0.77	0.74	0.70	0.69	0.67	0.65	0.68	0.68

(Source: Economic Survey of 2023-2024, Ministry of Agriculture, New Delhi, 2024.)

Note: * The data of 2023-24 is based on final estimates.

III. CROPPING PATTERNS IN INDIA

As we know, multiple factors involve a farmer's choice of what crops to grow, and sometimes, they can grow multiple crops on their farms as well as rotate a certain crop mix over time. However, it is vital to also point out that in order to improve the volume of production against maintaining soil fertility, good agricultural practices are always practiced in conjunction with particular cropping patterns and systems. Furthermore, cropping patterns are a dynamic concept because they morph over time and across space. They can be defined as a seasonal pattern and spatial arrangement of fallow and sowing in a certain space. Cropping patterns in India are influenced by temperature, rainfall, soil types, climate and technology. When classifying crops, consideration of the agroclimatic types, as well as identifying the crops, is also important. Cropping pattern is literally the geographical and temporal arrangement of the crops to be cultivated on a parcel of land. The cropping pattern refers to the spatial and temporal contribution of crops to a plot management system. Cropping patterns are the arrangements of crops on a farm, regional, provincial, or national scale that integrate natural factors including soil types and climate, yield, land quality, infrastructure, and the national agricultural policy. If the cropping pattern changes, the amount of land planted to each crop would change.

India's cropping patterns are seasonal and can be divided into three crop types, namely Kharif, Rabi, and Zaid. The main kharif crops include rice, jowar, bajra, maize, groundnut, and cotton, which are the salient indicator crops to represent kharif cropping practices. Similarly, the primary rabi crops include wheat, gram and jowar, which are the major crops to signify the rabi cropping pattern. The northern and interior parts of the country experience three distinct cropping seasons which are kharif, rabi, and zaid. The kharif season coincides largely with the arrival of the Southwest Monsoon, and during this period, it is possible to cultivate tropical crops, which include rice, cotton, jute, jowar, bajra, and tur. Winter arrives in October or November, marking the arrival of the rabi

season which lasts until March or April. The comparatively cooler temperatures allow for the cultivation of temperate and subtropical crops such as mustard, wheat, and gram. On the contrary, watermelon, cucumber, vegetables, and fodder crops are grown on irrigated land during zaid, the short summer cropping season, which occurs just after the rabi crop has been harvested. However, in the Southern parts of India, there is no such differentiation throughout the cropping season.

Table:3- Cropping Season & Crop Pattern in the Fiscal Year 2024-25.

Cropping Seasons	Major Crops Cultivated	
	Northern States	Southern States
(A)-Kharif (June-September)	Rice, Cotton, Bajra, Maize, Jowar, Tur	Rice, Maize, Ragi, Jowar, Groundnut
(B)-Rabi (October-March)	Wheat, Gram, Rapeseeds and Mustard, Barley	Rice, Maize, Ragi Groundnut, Jowar
(C)-Zaid (April-June)	Vegetables, Fruits, Fodder	Rice, Vegetables, Fodder

(**Source:** Compiled from the Agriculture Statistical Data.)

The data given in table-3 indicates a classification of crop patterns into Kharif, Rabi, and Zaid seasons. The crops can be classified as separate, together, or following a certain order (rotational cropping). One crop can be identified as occupying land for one season, or two crops can be obtained consecutively in a season (double cropping). More recently, at least more than two crops in a year have become standard. The intensive cropping is sometimes always done simultaneously, on consecutive sequences a cover crop is planted beneath a standing crop with a wide rowed, slow growing cropping pattern.

3.1. Commercial Crops: In recent years, there is a remarkable change in the crop pattern in India especially in the production of commercial crops. These types of crops are sugarcane, tobacco, potatoes, jute, tea, coffee, coconut, rubber, and condiment and spice crops. There are seasonal, annual, and perennial crops. Generally speaking, they are found in much smaller areas than food and other crops. However, the crops have commercial relevance. The crops are cropped patterns from semi-arid to humid regions of the country, also with many requiring special climatic regions. In addition, several horticultural crops, such as citrus, mango and apple, guava, grapes, berry, papaya and coconuts are some important cash crops. Monocropping occurs in several sugarcane-growing areas, and for the short-duration seasonal crops, cropping is done in between sugarcane crop phases. The rotation crops for Uttar Pradesh, Bihar, Punjab and Haryana, are wheat and maize, whereas some of these locations also raise rice. In addition to sugarcane, ragi, rice and pulses are grown in Tamil Nadu, Karnataka and Andhra Pradesh in the southern region. Cotton, jowar and pulses are grown in the state of Maharashtra. In the potato-growing area, wheat, maize and legumes are alternative crops. In the tobacco area, maize, oilseeds, and jowar are grown alternately based on the type of tobacco grown and the season. The typical alternative crop for the jute-growing region is rice.

3.2. Plantation Crops: It is common to intersperse plantation crops with fodder crops and pulses. Spices and condiments are frequently grown in fertile soils. Although ginger, onion, coriander, and turmeric are grown as mixed crops with seasonal crops, chillies are intercroped with jowar.

3.3. Mixed Cropping: Today in the changing agriculture pattern scenario, this crop pattern predominates in many regions of India. Therefore, a large number of researchers now recognize that mixing crops is the most effective use of land, as opposed to seeing it as an archaic practice. Recently, numerous innovative mixes have been suggested that ensure that land and sunlight are used efficiently. Breeders are developing varieties of oilseeds and pulses that can be used in row crops as well. Many farmers produce crop mixes, especially in the kharif

season, where pulses and certain oilseeds are grown in maize, jowar, or bajra. Upland rice is generally grown in a mix of varieties in eastern Uttar Pradesh, the Chotanagpur area of Bihar, and the Chhattisgarh division of Madhya Pradesh; however, lowland rice is not grown as a mix. Grain crop mixes such as wheat and barley, wheat and gram, or wheat + barley + gram are produced during the rabi season mainly in the nonirrigated northern regions of India. Farmers may also have safflower or brassica grown between wheat or even with gram.

IV. MAJOR CROPS REGIONS

A single crop is rarely grown in isolation, with crops usually being grown in mixtures. It is possible, however, to estimate the density and density of individual crops from the very interesting distribution maps of crops but it is even more important to see the integrated assemblage of the multiple crops that are grown in a region. Major crop regions in India that can be categorized based on some homogeneity and commonality are relatively categorizing: rice, wheat, cotton, millet and maize, Jowar- Bajra, and fruit and spice.

4.1. The Rice Region: It is the chief crop in a vast zone that runs from the lower Gangetic Plain to the eastern Brahmaputra Valley and through the alluvial plains along the circumcoastal areas of the peninsula. Aside from some isolated regions close to the Arabian Sea, rice is cultivated throughout the Bay of Bengal. Although rice is the foremost crop overall, this area can be divided further into the following zones:

(A)- Rice-Millets: This region includes all of Andhra Pradesh, southern parts of Orissa, and a few areas of Tamil Nadu.

(B)- Rice-Coffee-Spices: This area includes the Southern most parts of Kerala and Tamil Nadu.

(C)- Rice-Pulses-Millets: It exists in the western portion of the previous zone in central Bihar, eastern Madhya Pradesh, and eastern Uttar Pradesh.

(D)- Rice-Jute-Tea: This crop combination exists in the farthest east near the Assam Valley in northern West Bengal, the lower Gangetic plains.

4.2. The Wheat Region: This region encompasses Punjab, Haryana, Uttar Pradesh, Rajasthan, and the rest of northwest India. The two primary sub-regions are: Malwa, the Bundelkhand plateau, and a Wheat-Jowar-Bajra zone on the Vindhyan scarp. West Uttar Pradesh, Himachal Pradesh, and Jammu are characterized by wheat, maize, and sugar cane, and Punjab and Haryana represent the Wheat-Jowar-Bajra of the Indus Plain.

4.3. The Cotton Region: Some of the areas in India are famous for cotton grown because it is cultivated on black soil, which is found basically in the states of Gujarat and Maharashtra. For this reason, it is grown in North-West India, where cotton is the primary crop. As we know that cotton is grown in the Gujarat plain and Deccan trap area; cotton is essentially grown in the Valleys of Narmada, Tapti, Purna, and Sabarmati. Actually, cotton as a cash crop, is grown each time with one food grain preferably oil seeds, Bajra or Jowar. As a matter of fact, the varied sub-regions of this crop as: cotton-Jowar-Bajra are conveniently grown together in Maharashtra and Western Madhya Pradesh; Cotton-Pulses-Rice are grown in the developed in the banks of Narmada and Eastern Gujarat.

4.4. The Jowar-Bajra Region: Today all the regions with red soil and an average annual rainfall of between 50 and 100 cm are more likely to see Bajra-Jowar grown, as drought conditions create a preference for it. Likewise, Jowar-Wheat is a common legume across all of Rajasthan, Haryana, along with portions of Uttar Pradesh. Farmers grow Jowar-Cotton in Maharashtra, Bajra-Jowar-Pulses in semi-arid and arid regions across Rajasthan, and Jowar-Cotton-Oilseeds-Millets as well in both Karnataka and Maharashtra.

4.5. The Millet-Maize Region: Additionally, other accessible cereals, specifically Bajra, wheat, rice, and others like maize and ragi, are closely related in terms of production. Maize is commonly cultivated in Madhya Pradesh, Gujarat, and Rajasthan. In addition, over the last few years, a combination of maize, barley, and wheat has appeared in Himachal Pradesh, primarily in the Himalayan foothill area. In certain Aravalli areas, an unusual combination of maize, cotton, oilseeds, millet, and wheat are the crops cultivated. Ragi is the predominant crop in southern Karnataka.

4.6. The Fruit & Spice Region: In India, it is the smallest of all the crop regions. This region includes

mountain and high-altitude areas. The Nilgiri, Annamalai, Palni, and Cardamom hills in Tamil Nadu and Kerala as well as the 'Duns' and Valleys in the Himalayas could be classified as fruit and spice regions. Horticulture and plantations are the main farming activities taking place in this region.

V. FACTORS AFFECTING THE CROP PATTERN

All of us agree with the fact that rainfall, climate, temperature, and different types of soil keenly determine cropping patterns in India. Crop patterns are also influenced by the technology. Some of the crucial factors could be explained as follows:

5.1. Physical and Technical Factors: We know that the crop rotation in any area is affected by physical factors such as soil, climate, or rainfall, etc. Since jawar and bajra can grow with limited rainfall, there is a heavier reliance upon them in arid areas, which have scarce rainfall and climate uncertainty. This is the case in large parts of the country. In the technological sense, crop rotation can be altered. In other cases, it can be determined by physical coercion. In water-locked areas of the Punjab, districts of Sangrur and Ludhiana, rice has expanded its area because it can tolerate the additional water better than other crops that cannot tolerate it so readily. In Madhya Pradesh, millets can be grown on recently recovered fields a few years before switching to rice. Crops grown in an area can also be determined by the type of irrigation infrastructure, and access to it, that is utilized in addition to soil and climate. Not only can an alternative crop be grown when water is available, but it can also be grown and irrigated for two or three crops. The development of irrigation supplies can lead to a dramatic shift in farming practices. Since improved crop yields are possible, a new crop rotation may emerge where there was none before or improvements may be made on an existing rotation. The expanded irrigation infrastructure is one of the primary variables driving the increase in production of sugarcane, tobacco, etc.

5.2.Prices and Income Maximization: Most of the research has shown the relationship between price changes and patterns of crop production. A Ministry of Food and Agriculture study on the pricing parities of intercrops shows just how price changes impact shifts in acreage. There seem to be two effects that price has on acreage for crops. One, changes in acreage across crops is partly due to differences in inter-crop pricing parities. The second effect is that if there is not much doubt that price level with a crop is stable for several years, this should induce producers to increase output more than a very high price level. Some researchers contend that altering the crop pattern and the farmer choosing the combination of crops to grow to earn the highest possible income is the first and foremost effect of income maximization.

5.3. Size of Farm: The extent of the farm and the cropping pattern are closely linked. Small farmers use a lower percentage of their farm land for cash crop production than large farmers. One reason for this is that small farmers focus on growing food grains needed for their own subsistence. Only when they have met their own food grain needs do they begin to grow cash crops. In recent years, small farmers in particular have extended their sugarcane area even more than large farms. There is no question that the cropping pattern of small farmers has been over the years primarily controlled by subsistence needs.

5.4. Availability of Inputs: Access to inputs, such as: fertilizers, seed, water, storage, marketing, availability of credit and transport all are important factors determining the cropping pattern. Likely, the irrigation system would be the most economical of the additional facilities available, certainly one of the major factors stimulating many farmers to extend their area to groundnuts in Madhya Pradesh, Gujarat, Rajasthan etc.

5.5. Governmental Initiatives: Most of the scholars agree with the fact that a particular crop pattern may be associated by the governmental initiatives with the provision of a service or infrastructure. The use by farmers of a given crop pattern may be linked to the provision of seed, fertilizer, irrigation infrastructure, etc. The legal framework governing foodcrops, land use, intensive paddy, cotton, oilseeds, etc. schemes, and the use of excise and export duties sharply focuses attention on the fact that even when all the individual measures may push the crop pattern in the direction desired by that measure, the overall property on the total pattern of all the measures together may not serve national priorities or needs. All sorts of issues ranging from the farmers' own preferences, not having sufficient financial or other means, repeated

droughts, pest invasion, etc, can also mean that they may not select a set of crops that can grow from a financial perspective. Those decisions could be different if they had access to extra irrigation, fertilizer, or pesticides. If the farmer cannot obtain all of this on their own, the government may be able to help by obtaining them for them.

VI. CONCLUSION

Thus, we come to point out that in the present changing economic scenario in India, there are some of the crucial factors as discussed in the research paper that widely affect and determine the cropping pattern in the country. Despite the fact that Indian farmers are highly traditional and poor, by making the right investments in their economic incentives, their cropping pattern is rapidly changing and a large number of farmers are highly attracted and affected by the process of commercialization of the agriculture in recent years. And also, a sufficient number of farmers in India, seems ready to adapt to any better farming pattern that they see. Therefore, it is required that farmers in India should have the adequate financial and technical level of expertise to shift to better cropping patterns. It is clear from the above that economic factors are the most important determinants of cropping patterns. Today, every farmer in the country is seeking to switch to the cropping combination that will generate the highest possible return on each and every investment in the agriculture sector, which will surely influence the country's agriculture economy and will also bring drastic changes in the socio-economic life of Indian farmers. In spite of some initiatives taken by the government for the welfare of the farmers and labourers working in agriculture and its allied sectors, they are still not willing to shift to a better farming pattern due to the lack of awareness and proper support facilities. However, in these situations, the government can play an important role; but a considerable issue in the current economic changing scenario is that the land holding size is relatively small, and the technological advancement of agriculture has not been achieved through the appropriate means. Moreover, inadequate irrigation facilities, infrastructure, and the impact of natural calamities during the monsoon, have also had a negative impact on the cropped patterns in recent years in India.

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