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## **Agricultural Land - Use Changes and Correlation: A Case of Jaipur District of an Indian State**

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### **Abstract**

This research paper assesses the agricultural Land Use/Land Cover and correlations with different parameters for the Jaipur district of state of Rajasthan in India during the years 2001 and 2016. Changes in area, irrigation and production of Food Crops and Non-Food Crops were assessed, and deliberations were documented in this study for Jaipur district. Changes are mapped for better understanding of the patterns of crops. The outcomes are discussed in subsequent sections as the overall change in cropping pattern with respect to agricultural area, agricultural irrigated area and agricultural production of Jaipur district from 2001 to 2016. Matrix of Co-efficient of correlation between different categories of agricultural Land-use of Jaipur district was also calculated for making the good policies not only by local authorities but also by the farmers. Correlation between different categories viz cereals with pulses, oil seeds and other crops, pulses with oil seeds and other crops and oil seeds with other crops was also the topic of research in this study for better management of agricultural production. At the end of the research; Area of Low Intensity of Cropping, Area of Medium Intensity of Cropping, Area of High Intensity of Cropping and Volume Change in Intensity of Cropping was elaborated with high accuracy of collected data. Findings of this study may be helpful for the local authorities for better regulations of urban/rural plannings as well as it increases the public awareness for sustainable development.

**Keywords:** *Land Use, Food and Non-Food Crops, Changes, Area, Irrigation, Production, Correlation, Intensity of Cropping.*

### **1. Introduction:**

Agricultural land-use is a proportion of area used to grow different crops during the agricultural year. In other words cropping patterns are the extent to which the arable land under different agricultural activities can be put to use. Cropping pattern is, however, a dynamic concept as it changes over space and time because of it is a combine effect of physical, social, economic and technological factors at the particular time.

The study of crop association provides an adequate understanding of land and integrative reality that demands distributional analysis (A. Mohammad, 1978). The study of the agricultural land use not only provides base for understanding the complex structure of agricultural landscape of the region, but also helps for better planning. In this effort is made to study the cropping pattern and overall change in cropping pattern, correlation between different agricultural land-use categories, ranking of crops, crop combinations changes, crop concentration and pattern of diversification.

Cropping pattern of the study region is typical of an underdeveloped agricultural economy. Varieties of crops are grown in the study region. The overall cropping pattern of the region is outlined and it is followed by a discussion of the individual crops calculating the percentage of strength for each block derives the relative strengths of the crops grown. There is spatial variation in cropping pattern upon rain-fall and soil condition therefore detailed analysis of each tillage crop based on quinquennial average and respective changes mentioned in the sections 3.

## 2. Literature Review

In Indian economy, agriculture is the dominant sector, which effects the not only the overall growth of the nation but also determines the sustainability and maximum population still relies on this for employment and livelihood (Sunil Vithal Sunatkar, 2018; Jasbir Sing, 1976, Jasbir Singh and S S Delhi, 1984; Sing J.P., 1992). About 70 per cent population still relies on agriculture for employment and livelihood. Sunil Vithal Sunatkar (2018) in his study explained the crop concentration and diversification in agriculture of Gadchiroli district of Maharashtra. He done the study on the dominating crop as well as ranking of the crops in the cropping pattern from 2015 to 2016 along with study of the agricultural production influenced by physical, climatologically and other factors.

(Mazid Husen, 2002; Majid Husain, 1982) in their works covered the wide canvas of Human Geography covering the cultural, historical, political, regional, social, urban and economic aspects in respect to the agricultural production and documented the examples from developed and developing regions of the word.

## 3. Cropping Pattern

Most of the study region comes under drought prone area, where seasonal and uncertain rainfall is the main characteristics. Therefore, agricultural of the area depend on irrigation. Implementation of new technological inputs, machineries, High Yielding Varieties of seeds, commercial crops, chemical fertilizer and irrigation facilities supported to the agriculture and agricultural pattern. The cropping pattern of the study areas are very typical because, both dry land culture and irrigated culture are directly governed by other geographical factors and modified by the emergent, social and economic circumstances. Therefore, present section deals with cropping pattern and changes of crops in the Jaipur district. The crops of the region are classified into —

- **Food-crops**
- **Non-food-crops**

Table 1: Changes in cropping pattern of Jaipur district (2001 to 2016)

<b>Changes in cropping pattern of Jaipur District (2001 to 2016)</b>								
	Food Crops				Non Food crops			
	2001-02		2016-17		2001-02		2016-17	
	Cereals	Pulses	Cereals	Pulses	Oil seeds	Others	Oil seeds	Others
Area	73.38	9.76	60.29	23.06	16.29	0.56	15.96	0.68
Irrigation	71.31	8.02	67.68	2.52	19.67	0.99	29.08	0.72
Production	<b>76.69</b>	<b>8.25</b>	<b>65.87</b>	<b>16.66</b>	11.21	3.85	16.48	0.98

Source: Statistical outline of Jaipur District

Table 2: Changes in block-wise cropping pattern of Jaipur district (2001 to 2016)

Changes in cropping pattern of Jaipur District (2001 to 2016)																								
	Cereals						Pulses						Oil Seed						Others					
	Area		Irrigation		Production		Area		Irrigation		Production		Area		Irrigation		Production		Area		Irrigation		Production	
	2001-02	2016-17	2001-02	2016-17	2001-02	2016-17	2001-02	2016-17	2001-02	2016-17	2001-02	2016-17	2001-02	2016-17	2001-02	2016-17	2001-02	2016-17	2001-02	2016-17	2001-02	2016-17	2001-02	2016-17
<b>Kotputli</b>	66.43	66.66	57.95	40.2	73.4	75.89	6.92	1.08	5.75	1.07	5.68	0.6	26.44	31.84	36.03	58.36	20.03	23.43	0.21	0.42	0.27	0.37	0.89	0.08
<b>Virat Nagar</b>	75.72	90.26	73.48	82.32	83.15	92.65	12.5	0.67	11.22	0.12	7.27	0.52	11.37	7.64	14.72	17.52	8.84	5.71	0.41	1.43	0.58	0.05	0.74	1.12
<b>Shahpura</b>	75.3	88.55	70.41	79.76	75.73	87.5	10.7	1.08	11.19	2.09	9.54	1.53	13.73	9.84	17.92	17.93	11.61	9.82	0.27	0.53	0.48	0.21	3.11	1.15
<b>Chomu</b>	71.42	77.43	64.26	66.42	72.99	85.41	6.62	0.62	7.74	0.83	10.14	0.68	21.42	20.63	27.3	32.29	12.7	12.53	0.54	1.32	0.69	0.45	4.17	1.38
<b>Phulera</b>	77.05	59.52	71.65	72.92	74.33	71.74	13.68	30.07	13.93	1.12	16.49	16.29	8.8	9.82	13.44	25.71	7.86	10.19	0.59	0.59	0.98	0.25	1.33	1.78
<b>Dudu</b>	67.73	25.27	76.34	70.61	72.02	26.51	25.6	68.29	1.91	9.27	1.81	53.27	6.13	6.31	19.39	19.12	5.16	19.87	0.54	0.13	2.36	1.01	21.02	0.35
<b>Phagi</b>	63.46	33.43	75.88	51.71	74.68	36.47	10.33	43.82	1.34	7.59	1.41	37.71	26.06	22.71	22.34	40.5	23.47	25.68	0.15	0.04	0.45	0.2	0.44	0.14
<b>Sanganer</b>	83.1	87.89	82.18	82.93	92.63	88.98	5.45	2.08	2.04	0.64	1.12	0.99	9.35	9.52	12.12	15.1	4.56	9.19	2.09	0.51	3.67	1.33	1.69	0.82
<b>Jaipur</b>	79.11	77.95	71.7	64.86	65.91	75.78	5.99	0.23	7.63	0.28	6.47	0.1	13.27	19.24	18.4	32.42	7.94	18.69	1.62	2.58	2.26	2.52	19.67	5.36
<b>Ambler</b>	76.98	83.8	68.48	75.51	66.35	86.83	8.03	0.53	10.03	0.76	10.65	0.66	14.28	13.54	20.41	22.57	13.89	6.88	0.71	2.13	1.08	1.17	9.11	5.62
<b>Jamwar Ramgarh</b>	80.01	81.71	78.64	82.27	85.63	87.8	9.68	5.55	10.25	5.95	7.73	3.85	9.94	12.44	10.5	11.58	4.66	7.96	0.37	0.3	0.61	0.2	1.98	0.39
<b>Bassi</b>	84.54	79.37	86.97	79.4	93.06	87.37	3.25	3.07	3.93	2.12	5.4	1.64	12.03	15.29	8.83	16.07	4.51	9.38	0.18	2.27	0.33	2.43	0.18	1.69
<b>Chaksu</b>	59.43	58.13	76.67	65.93	75.73	69.41	4.43	9.41	3.18	4.39	3.03	9.33	36.07	32.29	19.98	29.4	20.76	21.08	0.07	0.17	0.17	0.29	0.49	0.17

Source: Statistical outline of Jaipur District

**3.1 Food crops:**

### **3.1.1 Area of food crops**

Food crops are very dominant in cropping pattern of study region. During the 2001-02, the district as a whole has 83.14 percent of area under food crops. The table 1 and 2 shows the regional variations of food crops ranging from 63 to 94 percent of the total cropped area. During the 2016-17, the district as a whole has 83.35 percent of area under food crops. The regional variations of food crops ranging from 67 to 94 percent of the total cropped area. The district as a whole has been gradually increasing the area under food crops about 0.21 percent.

### **3.1.2 Irrigation of Food crops**

Irrigation is very dominant in cropping pattern of study region. During the 2001-02, the district as a whole has 79.34 present of area under food crops. The table 1 and 2 shows the regional variations of irrigation ranging from 63 to 92 percent of the total cropped area. During the 2016-17, the district as a whole has 70.2 percent of area under irrigation. The regional variations of irrigation ranging from 40 to 90 percent of the total irrigation area. The district as a whole has been gradually decreasing the area under irrigation about -9.14 percent.

### **3.1.3 Production of food crops**

Production of food crops is a major part of total production of whole area. During the 2001-02, the district as a whole has 84.94 percent of production under food crops. The table shows the regional variations of food crops ranging from 72 to 96 percent of the total cropped production. During the 2016-17, the district as a whole has 82.53 percent of production under food crops. The regional variations of food crops ranging from 74 to 94 percent of the total cropped production. The district as a whole has been gradually decreasing the production under food crops about 2.41 percent.

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### **3.2 Non Food Crops:**

Non food crops include oil seed and other crops. Oil seeds, cotton, sugarcane, fruits and vegetables are included in non food crops. Ground-nut, taramira, rape and mustered are the major oil seed crops which are cropped in the study region. Other crop includes fruits and vegetables. Dry climate, limited water resource scarcity of rainfall on one side and increasing wants on other side both, these compel farmers to cultivate fruits and vegetables. The variety of fruits and vegetables is grown in the study region such as pomegranate, ber, aonla, lemon etc.

#### **3.2.1 Area of Non food crops**

During the 2001-02, the district as a whole has 16.85 percent of area under non food crops. The table 1 and 2 shows the regional variations of non food crops ranging from 6 to 37 percent of the total cropped area. During the 2016-17, the district as a whole has 16.64 percent of area under non food crops, which is lesser from 2001-02. The table shows the regional variations of non food crops ranging from 6 to 33 percent of the total cropped area. The district as a whole has been gradually decreasing the area under non food crops about 0.21 percent.

In case of non-food crop it has been concluded that overall increase in area was seen for Jaipur district which is 0.12 %, although it was very incremental but that shows some positive sign for agriculture sector. So it is seen that production depends on the type of soil and others facility in the area for better production of oil seeds and other non food crops.

#### **3.2.2 Irrigated area of non Food crops**

Table shows the oils seeds irrigated area change in percentage of the said regions for the year 2001-02 and 2016-17. The highest irrigation area for oil seeds in Kotputli region is found and it is increased by 22.33% than the year 2001-02. It is due to availability of good water bodies or rain water. Most of the farmers do farming by adopting scientific methods like testing of the field soil, by using tractors, drip irrigation system water and other devices. Also, the soil of this region suits for the oil seeds production.

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The oil seeds more demands due to more consumption and good market value. Hence, the oil seed production increase with minimum cost and farmers gets more profit. So, the irrigation areas increase for oil seeds in all the areas mentioned in the table excluding slightly decrement by 0.27% in irrigation area for the oil seeds in Dudu.

Table displays the other food items irrigated area change in percentage of the said regions for the year 2001-02 and 2016-17. It is due to availability of good water bodies or rain water and favorable climate. Nowadays most of the farmers do farming by adopting scientific methods like testing soil, by using tractors, drip irrigation system water, by providing artificial environment and other devices.

Also, the soil property is improved to suit for the other items production. Hence, the other items production increase with minimum cost due to reduction in transportation cost and farmers earns more. So, the irrigation areas increase for other items production in Bassi area and slightly increment found in Jaipur, Chaksu, Kotputli and Amber regions. These slightly increment and decrement in irrigation areas for other items production shows that less availability expert laborers, less scientific expertise and difficulty to keep other items fresher and longer. It also shows that some farmers have expertise for this type of farming.

### **3.2.3 Production of non food crops**

In the year 2001-2002, Dudu has seen the maximum production of oil seeds, with an increase by 14.71%, but observed the maximum decline in production of others, by 20.67%. it is followed by Jaipur with an increase in production by 10.75% but a decline in production of others by 14.31 %. A similar pattern has been observed for Jaipur district, Sanganer, Phagi, Kotputli and Chaksu. Amber on the other hand, has seen decrease in both the production of oil seeds and others, by 7.01 % and 3.49 % respectively. Similar pattern has also been observed for Chomu and Shahpura. Bassi has shown increase in production of both oil seeds and others, 4.79% and 1.51% respectively. Same statistics have been observed for Phulera.



## 4. Results and Discussions:

### 4.1 Overall Change in Cropping Pattern:

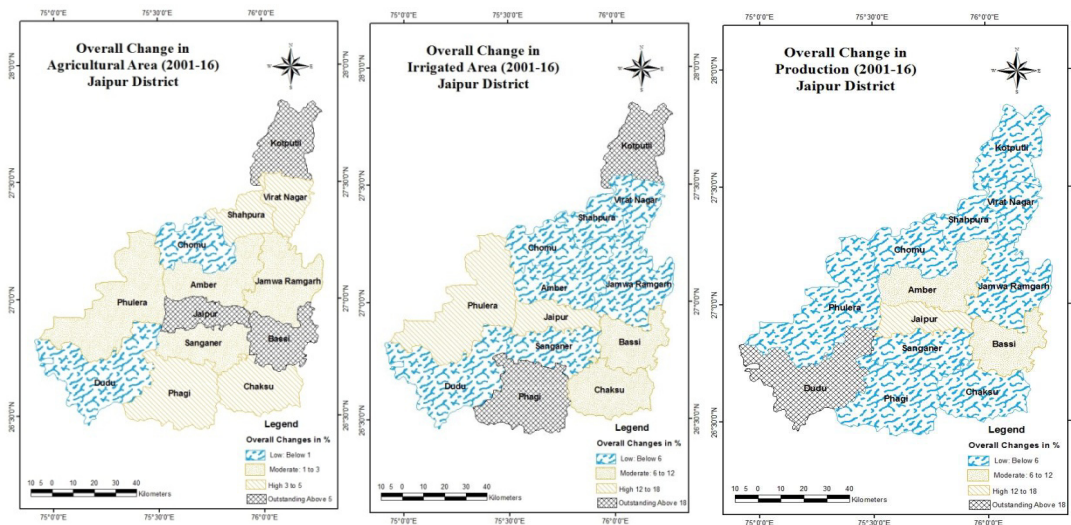
The change in agricultural land use means the change in proportion of cultivated area, production and irrigation under different crops at the different times. In order to measure the quantitative change Weavers Index (1954) is used. Index of change in agricultural land-use =  $A / B$  'A' is the sum of difference of percentage of crops of increase and 'B' is the sum of difference of percentage of crops of decrease for the period under review, the percentage of land, which is actually involved in transfer of area from one crop to other. Higher the index, higher is the changes in land-use pattern and lower the index more is the stability.

Table 3: Over all Change in cropping pattern % of Jaipur District (2001 to 2016)

<b>Over all Change in cropping pattern %</b>			
	<b>Area</b>	<b>Irrigation</b>	<b>Production</b>
<b>Dudu</b>	0.41	0.26	0.33
<b>Chomu</b>	0.79	1.08	2.21
<b>Phulera</b>	1.14	1.62	2.79
<b>Amber</b>	1.42	2.25	2.96
<b>Sanganer</b>	1.58	2.8	3.13
<b>Jamwa</b>			
<b>Ramgarh</b>	2.5	2.98	3.3
<b>Phagi</b>	3.46	4.99	3.4
<b>Virat Nagar</b>	3.73	9.37	3.75
<b>Chaksu</b>	3.78	9.54	4.63
<b>Shahpura</b>	3.89	12.27	6.3
<b>Bassi</b>	5.35	14.27	10.49

<b>Kotputli</b>	5.61	18.16	14.31
<b>Jaipur</b>	6.92	22.43	20.67
<b>Jaipur District</b>	0.33	9.41	5.27

Figure 1 A, B &amp; C: Over all Change in cropping pattern % of Jaipur District (2001 to 2016)



#### 4.2 Over all Change in Agricultural Area

Outstanding area of change with greater dynamism (over 5 percent) is observed in Bassi, Kotputli and Jaipur blocks. Because of in Bassi, Kotputli and Jaipur blocks, proportion of agricultural land area and irrigated area in food crops has decreased by more than two to four times during the period of investigation, while cultivated area and irrigated area in non food crop mainly oilseeds are increased, which is mainly brought under non food crops like sugarcane, fruit and vegetable. Jaipur block proportion of agricultural land area and irrigated area has decreased nearly twice. In Kotputli block irrigated area under food crops decrease more than 20 percent and increase the same

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area under non food crops. In Kotputli block irrigated area is increased from 14881 hectares to 24468 hectares under oil seed crops. The drip-irrigated area is increased highly, which is mainly brought under fruits and vegetable. The main crops of decreased cultivated area are barley and pulses.

The main crop of increased cultivated area is Bajara while decreased is pulses. In Shahpura block proportion of irrigated land shows stability in irrigated area, because in irrigated area under food crops and non food crops are change below 1 percent. The main crops of increased cultivated area are oil-seeds and sugarcane while decreased is tur and other pulses. the irrigated area under non food crops especially oil seed has increased and area under food crops especially wheat and barley has decreased. The main crops of cultivated area increased are Bajara, mustered, fruits, vegetable and other oil seeds, whereas crops of decreased cultivated area are other pulses and barley. In Phulera block, proportion of irrigated area is increased by more than one and half times during the period of investigation. Index of change computed reveals four different areas of changes is exhibited in Table 3 and Map 1 A.

#### **4.3 Over all Change in Agricultural Irrigated Area**

During the period of under review, irrigated cropping pattern is changed to a greater extent, due to expansion of irrigation, mechanization, introduction of fruits and vegetable because the policy of Government. The district as a whole has 9.41 percent change in irrigated cropping pattern.

Pulses has come up as main increased irrigated area crop, in the blocks Kotputli, Chaksu, Phagi, Bassi and Phulera, which collectively covers 71.77 percent area of region due to expansion of irrigation facility (Table 3 and Map 1 B). Bajara and Wheat is leading irrigated area crop in Jaipur, Chomu, Amber and Virat Nagar blocks, whereas in Shahpura, Dudu and Sanganer mustered is increased cultivated irrigated area crops due to expansion of seasonal

irrigation area. Fruits and vegetable are second increased cultivated irrigated area crop in five blocks out of thirteen blocks.

Regarding the crops of leading in decreased irrigated area, jowar and maze are an important crop, which lost irrigated highly in Chomu, Amber and Jaipur blocks, this area is replaced by bajara and groundnut. (Map 2) Other non food crops have lost high-irrigated area in Virat Nagar, Shahpura, Phagi and Chaksu blocks, which is replaced by pulses, Bajara, fruit and vegetable. Maize has lost highest irrigated area in Chomu and Amber, which is replaced by groundnut and Bajara.

#### **4.4 Over all Change in Agricultural Production**

Table 3 and map 1 C show overall change in agriculture production during the period 2001-02 to 2016-17. As evident from data, overall change is highly variable and diverse. On the basis of degree of change in agriculture production, Jaipur District can be divided into three regions namely high, moderate and low. Substantial increase in production (more than 10%) has been observed in Amber (10.49%), Jaipur (14.31%) and Dudu (20.67%) blocks. This high increase is mainly attributed to better irrigation facilities, relatively higher rainfall during the study period, availability of good quality seeds and supportive agricultural policies.

Considering all the common factors for increased crop yield, better irrigation facilities and fair remunerative price can be determining attributes for future agriculture policies.

#### **5. Conclusions**

Major part of the study area comes under drought prone category where seasonal and uncertain rainfalls are common phenomenon. Implementation of new technological inputs, machineries, high yielding varieties of seeds, commercial crops, chemical fertilizer and irrigation facilities supporting to the agriculture and agricultural pattern are currently under focus.

The crops of the region are classified into food-crops and non-food crops. The district as a whole has been gradually increasing the area under food crops about 0.21 percent per

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annum. During the 2016-17, the district as a whole has 1310 hector of area under productivity and gradual decrease in productivity has been observed. Non-food crops include oil seeds, cotton, sugarcane etc.

Overall change in cropping pattern change in agricultural land use means the change in proportion of cultivated area, production and irrigation under different crops at the different times. In order to measure the quantitative change Weavers Index (1954) is used for the analysis of percentage of crop increase or decrease. Higher the index, higher is the changes in land-use pattern and lower the index more is the stability.

Outstanding area of change with greater dynamism (over 5%) is observed in Bassi, Kotputli and Jaipur blocks. The main crops of increase in cultivated area are sugarcane, wheat and bajara, while decreased area under groundnut and mustard crops. The proportion between 1 to 3 percent changes (area of moderate change) is recorded in Phulera, Amber, Sanganer and Jamwa Ramgarh blocks.

Substantial increase in production (more than 10%) has been observed in Amber (10.49%), Jaipur (14.31%) and Dudu (20.67%) blocks. This high increase is mainly attributed to better irrigation facilities, relatively higher rainfall during the study period, availability of good quality seeds and supportive agro policies. This production increase could have been further enhanced with better irrigation facilities.

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