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Spatial-Temporal Change in the Pattern of Crop Diversification in Haryana

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ABSTRACT

Crop diversification means the diversity of various crops grown in a specific region. It also describes the shift from single crop farming to multiple crops farming.It is opposite to the crop concentration. In the present research work, an attempt has been made to analyse the changes in crop diversification spatially and temporally in the Haryana. The time period at which the analysis has been done is 1991-92 and 2011-12. The changes have been examined by Gibbs and Martin's Method of crop diversification. The analysis of crop diversification in the study area has been done for major crops separately. The average value of crop diversification index is 0.78 in the state during 2011-12. The value of crop diversification index decreased from 0.84 to 0.78 during 1991-92 to 2011-12 respectively in the state. Due to continuously increase in the crop specialisation mainly in the favour of wheat and rice crops. The changes in the crop diversification also identified in various agro-climatic zones of the state.

1. Introduction

Crop diversification means the diversity of various crops grown in a specific region. It is opposite to the crop concentration.It also provides a relationship between the relative areal strength of the crops grown in a region. In those regions where the level of agricultural mechanization, socio-economic development, and irrigation facilities is high, the level of crop diversification is low. It means that there is an opposite relationship between the technological development and the level of crop diversification. The level of crop diversification in a region has also been affected by the climatic and physical factors. That shows the level of crop diversification based on both physical and non-physical factors.

Crop diversification also describes the shift from single crop farming to multiple crops farming. The poor farmers mainly interested in the crop diversification. It means that it is helpful in generating employment in a region. If farmers adopt crop diversification it is also helpful in reducing the adverse effect of crop specialisation.

In Haryana crop specialisation continuously increases mainly in the favour of wheat and rice, due to this several problems emerges like groundwater depletion, decline soil fertility, ecological problems etc. That is why there is a need to study the present situation of crop diversification in the state and different agro climatic zones of the state spatially and temporally.

Economic and Statistical Organization, Planning Department Haryana, (2007) has divided the state into four agroclimatic zones which are conducive to different crops. An agro-climatic zoneis a land unit uniform in respect of climateand length of growing period which is climatically suitable for a certain range of crops and cultivators (FAO, 1983). Haryana has been divided into four following agroclimatic zones (Fig. 1.1):

1. **NorthernZone-**Panchkula, Ambala, Yamunanagar, Kurukshetra, Karnal and Panipat districts.
2. **Central Zone-** Kaithal, Jind, Sonipat, Rohtak and Jhajjar districts.
3. **Western Zone-**Bhiwani, Hisar, Fatehabad and Sirsa districts.
4. **Southern Zone-** Faridabad,Gurugram, Palwal, Nuh, Rewari and Mahendragarh districts.

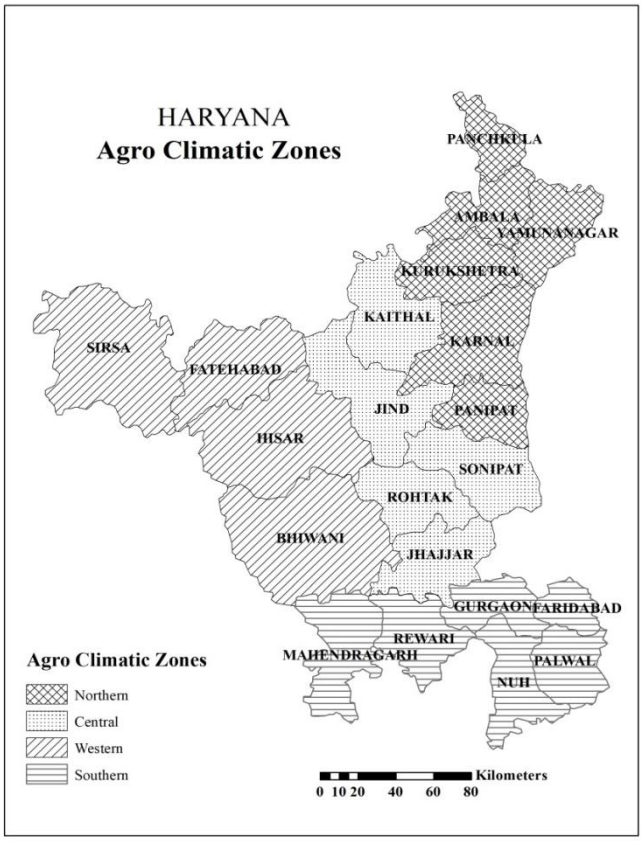

Fig. 1.1

2. Objectives of the study

The present study is undertaken with the following objectives –

- To examine the spatial-temporal change in the pattern of crop diversification in the state at district level.
- To analyse the spatial-temporal change in the pattern of crop diversificationin agroclimatic zones of the state.
- To Find out the reasons responsible for changes in the patternof crop diversification

3. Database and Methodology

Database

The present study is based on secondary data. The secondary data has been collected from Government of Haryana, Statistical abstract of Haryana.

Methodology

In this paper, thefirst attempt has been made to calculate the percentage share of individual crops in the total cropped area during 1991-92 and 2011-12.In this study an average of data for three successive years at any point of time will be used to avoid anomalies created by year to year fluctuations in weather. The data will be examined for the state at the level of districts.

The pattern of crop diversification in the present study has been analyzed with the help of Gibb's and Martin's method.Statistical equation of the method can be expressed as:

Index of Crop Diversification =1 $- \frac{\sum X^2}{(\sum X)^2}$

Here, X is the percentage of total cropped area under an individual crop. The index value of cropdiversification varies from 0.1 to 0.9.According to this formula; the index value is directly related tomagnitude of crop diversification. It means higher the indexvalue higher the magnitude of crop diversification and viceversa.

The analysis of crop diversification in the study area has been doneformajor crops (rice, wheat, bajra, jowar, gram, sugarcane, cotton, rapeseed & mustard and fruits & vegetables Table 1.2 & 1.3) separately.In different agroclimatic zones of Haryana also there are variations in the pattern of crop diversification. That is why, the study of major crops has been done separately in four agroclimatic zones of the stateand some minor crops (maize, barley, mash, moong, massar, ground nut, sesamum, and linseed), for which separate analysis could not be done included in the category of residual crops.

Spatial-temporal analysis of crop diversification based on Gibbs and Martin's Method

In the state, there are variations in crop diversification spatially and temporally. These variations have been examined byGibbs and Martin's Method of crop diversification. The time period at which the analysis has been done is 1991-92 and 2011-12.The crop diversification index of Gibbs and Martin's method has shown in table 1.1 and percentage of area under different crops shown in Table 1.2 &1.3 on this dataGibbs and Martin's method applied.The higher value of crop diversification index shows the high level of crop diversification and vice versa. The average value of crop diversification index was 0.78 of the Haryana state during 2011-12. It is observed from the table, that the value of crop diversification index decreased from 0.84 to 0.78 during 1991-92 to 2011-12.

The figure 2 shows that the high level of crop diversification was found in the western agroclimatic zone and low level of crop diversification was found in thenorthern agroclimatic zone of the state during 2011-12. It is observed from the table that there is a decline inthe crop diversification index value of all the agroclimatic zones of the state during 1991-92 to 2011-12. It shows that in the state there is a tendency of diversification to specialization of the crops. The maximum decline was found in the central agroclimatic zone from 0.81 to 0.71 during 1991-92 to 2011-12.

In different districts of the state also there are variations inthe index value of crop diversification. The highest index value of crop diversification was found in Bhiwani (0.83) district, followed by Hisar (0.79) district during 2011-12 respectively. The lowest index value of cropdiversificationwas found inKarnal (0.61) and Kaithal (0.61) districts, followed by Panipat (0.63) district during the time period respectively.

All these outcomes show that crop diversification index shows remarkable changes during the period in the state and also in the districts. Crop Diversification index divided into three categories for district-level analysis-

1. Areas of high crop diversification (> 0.80)
2. Areas of medium crop diversification (0.75 to 0.80)
3. Areas of low crop diversification (<0.75)

Areas of High Crop Diversification (> 0.80)

In this category, those districts are included whose Crop Diversification index value above 0.80. The high level of crop diversification has found in Bhiwani (0.83) district of the central agroclimatic zone of the state during 2011-12 (fig. 1.3). The reasons responsible for that are low rainfall, sandy soil, the large size of land holdings, inadequate irrigation facilities but with the time being the development of sprinkle irrigation resulted farmers grow the number of crops like wheat, oilseeds, cotton, pulses, rice, sugarcane etc in the district.

On the other hand, during 1991-92, thehigh level of crop diversification was found inSonipat (0.83) and Rohtak (0.82) districts of the central agroclimatic zone of the state (Table 1.1). The reasons responsible for that are low rainfall, lack of irrigation facilities, fertile soil and flat land.Hisar (0.82) district of the western agroclimatic zone also falls in the category of high level crop diversification. The reasons responsible for that are low rainfall, lack of irrigation facilities, sandy soil etc.

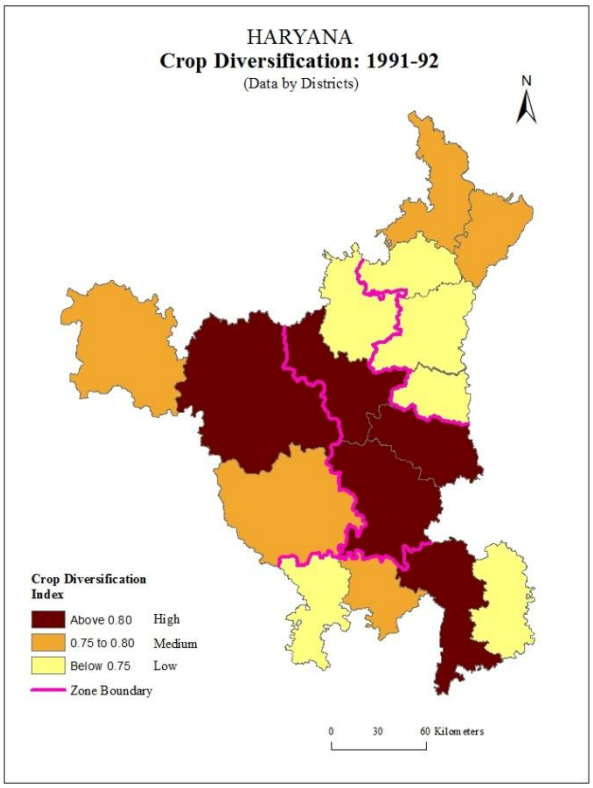

Figure-1.2

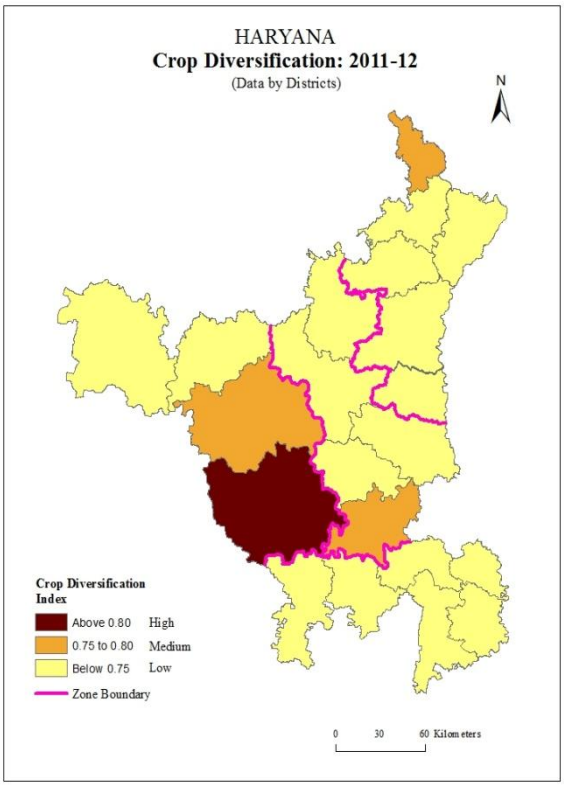

Figure-1.3

It is observed from the figure 1.2 &1.3that the Rohtak and Hisar districts have shifted from high to medium level of crop diversification. Sonipat district has shifted from high to low level of crop diversification. That is happen because of development of irrigation facilities, transport connectivity, fertile soil,flat land and well developed agricultural infrastructure due to these facilities farmers shift from diversification to specialization of the crops in these districts gradually.

Areas of Medium Crop Diversification (0.75 to 0.80)

In this category districts having 0.75 to 0.80 crop diversification index value are included. The medium level of crop diversification has found in Panchkula (0.76) district of the northern agroclimatic zone during 2011-12.The reasons responsible for the medium level of crop diversification are inadequate irrigationfacility, hilly topography etc.Rohtak (0.75) and Jhajjar (0.76) districts of the central agroclimatic zone, Nuh (0.75) district of the southern

Table 1.1
Haryana: Crop Diversification Index, 1991-92 to 2011-2012.

Agro climatic zone/Districts	Crop Diversification Index	
	1991-92	2011-12
Ambala	0.76	0.65
Panchkula	-	0.76
Yamunanagar	0.78	0.70
Kurukshetra	0.67	0.63
Karnal	0.64	0.61
Panipat	0.68	0.63
Northern	**0.71**	**0.65**
Kaithal	0.67	0.61
Sonipat	0.83	0.66
Rohtak	0.82	0.75
Jhajjar	-	0.76
Jind	0.80	0.71
Central	**0.81**	**0.71**
Faridabad	0.74	0.70
Palwal	-	0.67
Gurugram	0.80	0.70
Nuh	-	0.75
Rewari	0.77	0.72
Mahendragarh	0.74	0.72
Southern	**0.80**	**0.78**
Bhiwani	0.79	0.83
Hisar	0.82	0.79

Fatehabad	-	0.71
Sirsa	0.79	0.73
Western	**0.84**	**0.80**
Haryana	**0.84**	**0.78**

Source: Computed by Gibbs and Martin's method

Agro climatic zone and Hisar(0.79) district of western agro climatic zone also included in this category.The reasons responsible for that are low rainfall, developed irrigation facilities, transport connectivity in Rohtak and Jhajjar districts, on the other hand in Nuh and Hisar districts sandy soil, low rainfall, inadequate irrigation facilities, lack of agricultural infrastructure facilities respectively.

On the other hand, during 1991-92, the medium level of crop diversification was found inAmbala (0.76)andYamunanagar (0.78) districts of northern agroclimatic zone, Gurugram(0.80) and Rewari (0.77) districts of southern agroclimatic zone, Bhiwani (0.79) and Sirsa (0.79) districts of western agroclimatic zone of the state.

It is observed from the figure 1.2 &1.3that the Ambala, Yamunanagar, Gurugram, Rewari and Sirsa districts has shifted from medium to low level of crop diversification.Bhiwani district has shifted from medium to high level of crop diversification in the state.

Areas of low crop diversification (< 0.75)

In this category Ambala (0.65), Yamunanagar (0.70), Kurukshetra (0.63), Karnal (0.61) and Panipat (0.63) districts of northernagroclimatic zone areincluded during 2011-12. Kaithal (0.61), Sonipat (0.66) and Jind (0.71) districts of central agroclimatic zone, Faridabad (0.70), Palwal (0.67), Gurugram (0.70), Rewari (0.72) and Mahendragarh (0.72) districts of southern agroclimatic zone and Fatehabad (0.71) and Sirsa (0.73) districts of western agro climatic zone also included in this category.The reasons responsible for that are developed irrigation facilities, developed agricultural infrastructure, fertile soil, well transport connectivity andwell developed socio-economic environment due to these facilities farmers grow those crops which are more suitable according to these facilities. As a result in these districts, farmers are shifted from diversification to specialization of the crops.

4. Conclusion

There are variations in the pattern of crop diversification in the state during 1991-92 to 2011-12. It has been analysedthat the index value of crop diversification decreased from 0.84 to 0.78 in the state during the time period. It is observed that there is a decline in crop diversification index value of all the agro climatic zones of the state. Maximum decline was found in central agro climatic zone from 0.81 to 0.71, a decreased by 0.10 during 1991-92 to 2011-12, followed by northern agro climatic zone from 0.71 to 0.65 respectively. The reasons responsible for that are adequate irrigation facilities, developed transport network and market facilities in northern and central agro climatic zone, which lead to specialization of crops mainly in favour of wheat and rice. The high level of crop diversification was found in western agro climatic zone and low level of crop diversification was found in northern agro climatic zone of the state during the 2011-12.

In different districts of the state the highest index value (above 0.80) of crop diversification has found in Bhiwani (0.83) district of western agro climatic zone during 2011-12. The medium level (0.75 to 0.80) of crop diversification has found in Hisar, Panchkula, Jhajjar, Rohtak and Nuhdistricts.The low level (below 0.75) of crop diversification has found inAmbala, Yamunanagar, Kurukshetra, Karnal(0.61),Panipat,Kaithal (0.61), Sonipat,Jind,Faridabad, Palwal, Gurugram, Rewari,Mahendragarh,FatehabadandSirsa districts of the state. The reasons behind these variations are developed irrigation facilities, agricultural infrastructure,mechanization of agriculture, well developed socio-economic environment etc. The districts with high level of these facilities fall under the category of low level of diversification and where these facilities not good condition fall in the category of high level of crop diversification. There are also some climatic and physical factors responsible for that like rainfall, temperature, soil, topography etc. After the analysis there is a shift identified from crop diversification to crop specialisation in the state.That is happen due to the development offacilities regarding agriculture.

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Table 1.2
Haryana: Percentage of Area under Different Crops to total Cropped Area in 1991-92

Districts/Agro climatic zones	Rice	Wheat	Bajra	Jowar	Other Cereals	Gram	Other Pulses	Sugarcane	Cotton	Rapeseed & Mustard	Other Oil seeds	Fruits & Vegetables	Residual crops
	Percent to Total Cropped Area												
Ambala	24.61	38.51	0.53	0	7.75	1.43	3.20	4.35	0.22	1.84	1.80	2.91	12.83
Yamunanagar	22.52	31.76	0.76	0.07	3.28	1.00	2.07	22.35	0.16	0.85	1.07	1.49	12.62
Kurukshetra	38.97	40.54	0.08	0	0.62	0.18	0.71	4.73	0.05	0.58	1.71	2.80	9.05
Karnal	39.66	43.44	0.31	0.07	0.64	0.22	0.96	2.46	0.15	0.22	0.85	1.03	10.01
Panipat	31.13	45.48	0.71	0.37	0.47	0.27	1.56	3.76	0.30	0.41	0.71	1.86	12.97
Northern	**32.59**	**40.39**	**0.44**	**0.09**	**2.39**	**0.57**	**1.61**	**6.61**	**0.17**	**0.73**	**1.22**	**1.96**	**11.23**
Kaithal	31.35	46.32	2.72	0.26	0.38	0.50	1.12	1.77	2.18	2.06	0.51	0.31	10.52
Sonipat	12.42	29.83	2.48	5.41	19.84	0.46	5.06	5.09	0.53	2.99	1.85	3.10	10.92
Rohtak	1.08	34.64	9.52	11.73	2.38	4.80	3.58	4.92	2.19	17.31	0.12	0.81	6.91
Jind	10.76	38.48	10.16	1.22	0.67	4.19	1.92	2.71	11.04	4.62	0.35	0.72	13.14
Central	**13.33**	**37.93**	**6.86**	**4.81**	**4.18**	**2.85**	**2.72**	**3.52**	**4.46**	**7.53**	**0.56**	**1.03**	**10.25**
Faridabad	3.20	46.44	9.24	8.32	2.61	0.36	3.48	4.38	0.12	7.64	0.46	1.23	12.51
Gurugram	0.51	31.65	19.72	6.63	3.49	3.91	0.71	0.17	0.01	21.85	0.52	1.18	9.65
Rewari	0.00	21.72	28.06	1.82	3.14	5.60	0.03	0.00	0.02	30.58	0.15	0.14	8.73
Mahendragarh	0.00	12.95	37.80	0.07	0.90	11.53	0.07	0.00	0.07	28.22	0.01	0.34	8.05
Southern	**0.94**	**28.38**	**23.58**	**4.35**	**2.51**	**5.39**	**1.09**	**1.14**	**0.06**	**21.76**	**0.30**	**0.76**	**9.75**
Bhiwani	0.00	11.10	30.28	0.53	0.71	26.67	1.06	0.17	4.65	15.12	0.06	0.33	9.32
Hisar	3.91	27.50	8.85	0.10	0.87	12.24	0.64	0.48	25.02	9.33	0.47	1.08	9.51
Sirsa	4.45	29.64	1.09	0.01	1.30	12.77	0.13	0.02	29.86	8.88	0.70	0.61	10.54
Western	**2.99**	**23.61**	**12.58**	**0.19**	**0.94**	**16.32**	**0.62**	**0.27**	**20.78**	**10.79**	**0.42**	**0.75**	**9.74**

***Source**: Statistical Abstract of Haryana 1990, 1991, 1992.*

Table 1.3
Haryana: Percentage of Area under Different Crops to total Cropped Area in 2011-12.

Districts/Agro climatic zones	Rice	Wheat	Bajra	Jowar	Other Cereals	Gram	Other Pulses	Sugarcane	Cotton	Rape seed & Mustard	Other Oil seeds	Fruits & Vege tables	Residual crops
	Percent to Total Cropped Area												
Ambala	39.92	42.16	0.21	0.00	0.55	0.03	0.68	4.73	0.0	0.63	0.08	1.67	9.34
Panchkula	22.42	39.68	2.66	0.56	14.11	0.48	2.02	1.05	0.0	3.71	0.08	3.20	10.02
Yamunanagar	34.17	39.83	0.33	0.00	0.52	0.05	0.74	12.34	0.0	1.26	0.19	2.17	8.41
Kurukshetra	43.31	41.74	0.00	0.00	0.16	0.04	0.32	3.41	0.0	0.55	1.16	3.43	5.89
Karnal	43.65	44.35	0.20	0.00	0.14	0.03	0.25	2.83	0.0	0.26	0.02	1.24	7.04
Panipat	39.95	45.33	0.23	0.00	0.03	0.00	0.38	3.44	0.0	0.47	0.00	1.78	8.36
Northern	**40.24**	**42.73**	**0.26**	**0.02**	**0.70**	**0.04**	**0.49**	**4.83**	**0.0**	**0.68**	**0.29**	**2.05**	**7.67**
Kaithal	41.75	45.43	1.70	0.00	0.01	0.03	0.04	0.70	2.0	0.21	0.01	0.40	7.73

Sonipat	30.41	49.21	3.64	2.71	0.23	0.00	0.69	2.49	0.3	0.81	0.00	2.13	7.34
Rohtak	16.76	44.91	8.70	8.37	1.28	0.36	2.20	3.34	4.1	5.90	0.01	0.82	3.26
Jhajjar	12.21	42.37	16.10	5.97	2.07	0.22	2.01	1.10	0.6	13.16	0.07	0.57	3.53
Jind	24.12	45.62	6.63	0.01	0.14	0.03	0.10	0.59	12.5	0.97	0.02	0.39	8.92
Central	**26.72**	**45.68**	**6.55**	**2.55**	**0.56**	**0.10**	**0.77**	**1.44**	**4.8**	**3.20**	**0.02**	**0.80**	**6.77**
Faridabad	16.09	47.36	5.99	1.73	0.36	0.00	0.66	1.07	0.1	1.12	0.15	4.88	20.50
Palwal	16.54	50.73	4.15	4.05	0.50	0.00	0.59	1.19	0.3	1.73	0.03	0.42	19.79
Gurugram	4.39	44.79	29.09	0.79	1.55	0.00	0.55	0.03	0.1	11.79	0.30	2.04	4.62
Nuh	3.27	42.97	14.79	6.83	0.64	0.22	0.92	0.36	0.0	15.55	0.22	2.21	12.00
Rewari	1.39	24.98	31.18	0.38	0.85	0.02	0.54	0.00	0.6	33.82	0.17	0.62	5.44
Mahendragarh	0.00	15.30	37.17	0.02	0.29	3.09	0.19	0.00	0.8	33.51	0.05	0.19	9.38
Southern	**5.49**	**33.77**	**23.13**	**2.18**	**0.64**	**0.90**	**0.52**	**0.36**	**0.4**	**20.06**	**0.13**	**1.16**	**11.26**
Bhiwani	2.44	21.49	20.88	0.00	1.59	6.38	1.01	0.28	7.1	21.36	0.06	0.33	17.04
Hisar	6.79	36.09	6.80	0.00	0.86	2.04	1.69	0.17	22.1	10.03	0.13	0.83	12.44
Fatehabad	20.75	44.26	1.26	0.00	0.75	0.13	0.22	0.03	20.4	2.43	0.19	0.59	8.95
Sirsa	8.77	40.78	0.51	0.01	1.04	1.04	0.31	0.00	27.7	5.58	0.37	1.03	12.88
Western	**8.44**	**34.56**	**8.17**	**0.00**	**1.11**	**2.70**	**0.85**	**0.13**	**15.2**	**10.78**	**0.19**	**0.70**	**17.21**

Source: *Statistical Abstract of Haryana, 2010, 2011, 2012*