



Statistical Evaluation of Regional Level Agricultural and Socio-Economic Development in Haryana

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Abstract: The present study examines inter-district development inequalities in Haryana and identifies key agricultural and socio-economic dimensions. More than fifty indicators for development use Composite index and main component analysis were used to access the development status (PCA). In addition, main component analysis (PCA) has been used to identify key agricultural and socio-economic development indicators. The study showed a considerable degree of inequality among all the districts, with Nuh being behind in both development sectors, but Gurugram and Faridabad were socioeconomically developed despite being behind in agriculture. Population densities in cities, industrial infrastructure and educational facilities have been identified as major factors in socioeconomic development. Karnal, Kurukshetra and Yamunanagar were agriculturally developed and percentage of cereals and food grain areas, yield, irrigation facilities and livestock were observed as major factors contributing to the development of the farming sector.

Keywords: Composite index, Normalized index, Principal component analysis, Factor loadings

Development status in any sector cannot be measured by a single indicator because it is a multidimensional phenomenon. The quality of life depends on the state of development in different industries; socio-economic, farming and infrastructure, etc. But a single indicator cannot fully grasp the development process (Muthumurugan and Christina 2021). In addition, many separately examined indicators do not provide an easy to understand picture of genuine patterns of development. India is an agricultural country of great significance in the field of agriculture development because nearly half of India's workforce is involved in farming for their livelihood. Agriculture provides the majority of low-income, disadvantaged and vulnerable people with a source of income and food security. Only by placing agriculture at the top of its agenda can India meet its targets of poverty reduction, malnutrition and inclusive growth, as India remains the world's largest population of poor and malnourished people (Singh et al 2020). Agriculture also provides the basis for a number of agro-based companies and agro-services. Apart from agriculture, the socio-economic sector is also an important sector which contributes greatly to improving the lives of citizens (Van et al 2015). In underdeveloped countries as well as in rich countries around the world, socio-economic development has picked the interests of policy makers. The aim of the economic planning of a country is to achieve balanced

regional development and reduce regional differences in development rates. In India, most countries are purely dependent on agriculture for their livelihood, including Haryana (Hooda et al 2017). Agriculture plays an important role in the socioeconomic growth of the state (Chander 2017). This research paper objectives on Haryana's inter-district development disparities and on the key characteristics of regional inequality in agriculture and the socio-economic sector in Haryana, which has a major influence on the state's developmental disparities.

MATERIAL AND METHODS

The unit of analysis were single district in the state of Haryana. The relevant data on agriculture and socioeconomic sectors was gathered from several issues of the Haryana government's Statistical Abstractson 27 agricultural and 25 socio-economic developments for all the districts of Haryana. To access the status of socio-economic development indicators were collected under different sections like; population, transport and educational facilities, infrastructure, finance and labour. The agricultural development status indicators of various sections like; area, yield, mechanization, human labour, other inputs and livestock were selected. Triennium average of area and yield related agricultural variables have been used in the study (Mishra et al 2017 & 2021).

Construction of composite development index (Narain et al, 1991, Das et al 2017): Let X_{ij} denote be the value of j th indicator of development for the i th district, where $i = 1, 2, \dots, n$ and $j = 1, 2, \dots, p$. The methodological steps for construction of CI given by Narian et al (1991) are summarized below:

Step-1: Standardize data for each indicator using the transformation

$$Z_{ij} = \frac{X_{ij} - \bar{X}_j}{s_j} \text{ where } s_j^2 = \frac{1}{n} \sum_{i=1}^n (X_{ij} - \bar{X}_j)^2 \text{ and } \bar{X}_j = \frac{1}{n} \sum_{i=1}^n X_{ij}$$

From Z_{ij} , identify the best value of each indicator. Let it be denoted as Z_{oj} . The best value will be either the maximum value or the minimum value of the indicator depending upon the direction of the impact of indicator on the level of development. For obtaining the pattern of development c_i of i th districts

$$\text{development } C_i \text{ of } i\text{th districts } C_i = \left[\sum_{j=1}^p (Z_{ij} - Z_{oj})^2 \right]^{1/2}$$

Composite index of development (C. I.) is given by:

$$D_i = C_i / (\bar{C} + 2SD_i), \text{ where } \bar{C} = \text{Mean of } C_i \text{ and } SD_i = \text{Standard deviation of } C_i.$$

According to Narian et al (1991) the value of composite index is non-negative and lies between 0 and 1. Also, a value closer to zero indicates the higher level of development while the value closer to 1 indicates the lower level of development.

Identification of key indicators using principal components: Principal component analysis (PCA) reduces to a smaller number of linear combinations the original set of variables which capture the maximal variation of the data. The main component analysis mainly explores the variance and covariance structure through some linear combinations of original variables. The usual PCA results ensure that keeping the top few main components with the highest associated variance provides a subset of linear combinations of the other main component that is closest to the source data. The first main component (PC1) is a weighted linear combination of the most variable variables in the data. The

Table 1. Selected socio-economic indicators

Section	Indicator	Notation
Population	Percentage of rural population male to total population	X1
	Percentage of rural population female to total population	X2
	Percentage of urban population male to total population	X3
	Percentage of urban population female to total population	X4
	Population density	X5
	Rural sex ratio of births (male per 100 female)	X6
	Urban sex ratio of births (male per 100 female)	X7
	Decennial population growth 2001-11	X8
Transport and other	Number of registered factories per lakh population	X9
	Road length per lakh population	X10
	Number of non-transport vehicle registered total per lakh population	X11
	Total transport per lakh population	X12
	Number of medical institutions allopathic per lakh population	X13
Educational services and infrastructure	Literacy percentage male	X14
	Literacy percentage female	X15
	Total senior secondary/high schools per lakh population	X16
	Total recognised middle schools per lakh population	X17
	Total recognised primary schools per lakh population	X18
	Teacher pupil ratio primary	X19
	Teacher pupil ratio middle	X20
Financial	Teacher pupil ratio senior sec/high school	X21
	Total cooperative societies and banks per lakh population	X22
	Credit deposits ratio (%)	X23
Labour	Percentage of workers employed in working factories to total population	X24
	Main workers as percentage to total population	X25

second main component, the weighted linear combination (PC2), is not related to PC1 and represents the majority of the remaining data variations and so on.

RESULTS AND DISCUSSION

Socio-economic status of development: Development indicators selected for socio-economic sector are given in Table 1. Gurugram (0.58) took first place in socio-economic development followed by Faridabad, Panchkula Panipat and Rewari. The least developed socio-economic districts were Jind, Sirsa, Bhiwani and Kaithal. The first major component to the socio-economic sector explained 45.07% of the overall variance and up to 5 PCs almost 85% of the overall variation (Fig. 1). Gurugram, Faridabad, Panchkula and Panipat districts have high main PC1 and PC2 component values. The districts of Nuh, Sirsa, Mahendragarh, Bhiwani and Fatehabad on the other hand have low scores in both the main components of the indicators of the agricultural sector. Socio-economic sector loadings indicators percentage of urban population male and female to total population, population density, number of registered factories per lakh population, number of non-transport vehicle and total

transport per lakh population, teacher pupil ratio primary and percentage of workers employed in working factories to total population were the most important variables for first principal component from the socio-economic sector. The other indicators literacy percentage male and literacy percentage female were also having higher values.

Agricultural status of development: The details of the development indicators selected for agricultural sector (Table 4). Karnal, Kurukshetra, Yamaunagar, Jind, Kaithal and Sirsa were highly developed districts in agricultural sector. Nuh, Gurugram, Faridabad, Rewari and Jhajjar were among the least developed districts in agricultural sector. The first key part of the agriculture sector was 30.74% of the total variance and almost 80% of the total variance was captured by up to 5 PCs (Fig. 2). Yamaunagar, Karnal, Kurukshetra, Kaithal and Jind districts have high main PC1 and PC2 component ratings. The Nuh, Rewari, Mahendragarh and Jhajjar districts, on the other hand, have low values for both of the principal components of farm indicators. The lower PC2 values are Panchkula, Faridabad, and Gurugram. The development differences indicated by PC1 and PC2 are consistent with the disparities reflected in the standardized

Table 2. Socio-economic development status

Rank	District	Composite index (↓)	Normalized index (↑)	PC value (↑)	District	Rank
1	Gurugram	0.583	1.000	9.115	Gurugram	1
2	Faridabad	0.654	0.787	9.080	Faridabad	2
3	Panchkula	0.743	0.523	2.419	Panipat	3
4	Panipat	0.761	0.471	1.906	Panchkula	4
5	Rewari	0.808	0.332	0.710	Ambala	5
6	Jhajjar	0.824	0.282	0.646	Rohtak	6
7	Yamunanagar	0.827	0.275	0.593	Yamunanagar	7
8	Rohtak	0.828	0.272	0.164	Sonipat	8
9	Ambala	0.852	0.199	-0.532	Rewari	9
10	Sonipat	0.855	0.190	-0.547	Karnal	10
11	Karnal	0.858	0.181	-0.767	Palwal	11
12	Palwal	0.863	0.166	-0.887	Jhajjar	12
13	Hisar	0.865	0.160	-1.207	Hisar	13
14	Mahendragarh	0.878	0.122	-1.396	Kurukshetra	14
15	Kurukshetra	0.883	0.106	-1.919	Jind	15
16	Bhiwani*	0.884	0.104	-2.411	Mahendragarh	16
17	Kaithal	0.885	0.102	-2.564	Sirsa	17
18	Fatehabad	0.900	0.058	-2.654	Kaithal	18
19	Jind	0.903	0.048	-3.058	Nuh	19
20	Sirsa	0.919	0.000	-3.117	Bhiwani*	20
21	Nuh	0.919	0.000	-3.574	Fatehabad	21

*Bhiwan includes the values of Charkhi Dabri

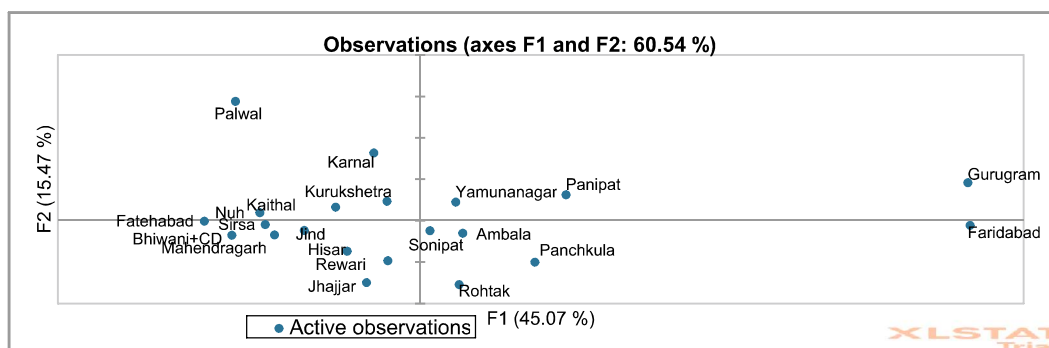


Fig. 1. Socio-economic sector principal component plot

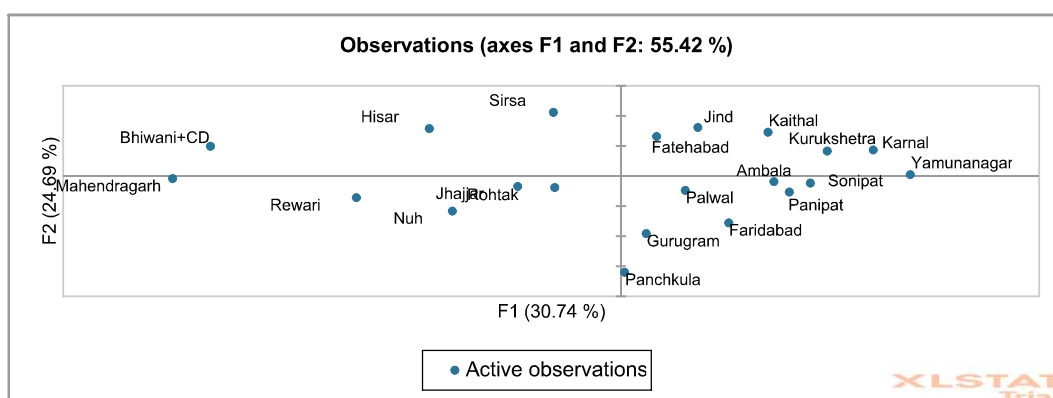


Fig. 2. Agricultural sector principal components plot

Table 3. Important indicators in socio-economic development

Indicator	F1	F2	F3	F4	F5
X1 Rural population male to total population (%)	-0.950	0.102	-0.217	-0.041	0.116
X2 Percentage of rural population female to total population	-0.948	0.131	-0.201	-0.053	0.139
X3 Percentage of urban population male to total	0.952	-0.116	0.206	0.046	-0.117
X4 Percentage of urban population female to total	0.946	-0.116	0.214	0.048	-0.138
X5 Population density	0.848	0.314	-0.159	0.030	-0.280
X6 Rural sex ratio of births (male per 100 female)	0.127	-0.338	-0.471	0.437	0.014
X7 Urban sex ratio of births (male per 100 female)	-0.172	-0.094	-0.556	-0.260	0.283
X8 Decennial population growth	0.666	0.396	-0.010	-0.062	0.599
X9 Number of registered factories per lakh population	0.911	0.000	-0.121	0.096	0.092
X10 Road length per lakh population	-0.777	-0.311	0.154	0.205	0.173
X11 Number of non-transport vehicle registered total per lakh population	0.775	-0.176	-0.015	-0.105	0.498
X12 Total transport per lakh population	0.844	-0.023	-0.135	-0.085	0.468
X13 Number of medical institutions allopathic total per lakh population	-0.906	-0.326	-0.036	-0.058	0.113
X14 Literacy percentage male	0.535	-0.608	-0.219	-0.322	-0.135
X15 Literacy percentage female	0.637	-0.589	0.173	-0.098	-0.164
X16 Total senior secondary/high schools per lakh population	-0.179	-0.634	-0.597	0.077	-0.211
X17 Total recognised middle schools per lakh population	0.205	0.838	0.085	-0.270	-0.230
X18 Total recognised primary schools per lakh population	-0.522	0.000	0.459	-0.452	0.188
X19 Teacher pupil ratio primary	0.769	-0.113	-0.480	0.023	-0.269
X20 Teacher pupil ratio middle	-0.453	-0.526	-0.344	-0.155	0.154
X21 Teacher pupil ratio senior sec/high school	0.055	0.824	-0.286	0.324	0.033
X22 Total cooperative societies and banks per lakh population	0.083	-0.273	0.769	-0.228	-0.062
X23 Credit deposits ratio (%)	-0.325	0.015	0.313	0.796	0.127
X24 Percentage of workers employed in working factories to total population	0.918	-0.023	-0.153	0.041	0.325
X25 Main workers as percentage to total population	0.307	-0.579	0.535	0.368	0.166

Table 4. Selected agricultural indicators

Section	Indicator	Notation
Area	Forest area to total geographical area (%)	X1
	Percentage of net area sown to total cultivable area	X2
	Percentage of area sown more than once to total cultivable area	X3
	Net area irrigated percentage to net area sown	X4
	Percentage of total cereals area to total cropped area	X5
	Percentage of total pulses area to total cropped area	X6
	Percentage of total food-grains area to total cropped area	X7
	Percentage of total oilseeds area to total cropped area	X8
	Average land holding size	X9
Yield	Total cereals yield	X10
	Total pulses yield	X11
	Total food-grains yield	X12
	Total oilseeds yield	X13
Mechanization	Number of tractors 000 ha ⁻¹ of total cropped area	X14
	Number of tube-wells and pumping sets	X15
Human labour	Percentage of cultivator worker to total workers	X16
	Percentage of agriculture worker to total workers	X17
Other inputs	Irrigation intensity (gross irrigated area x 100/net irrigated area)	X18
	Fertilizer consumption kg ha ⁻¹	X19
	Regulated markets	X20
	Rainfall annual (cm)	X21
Livestock	Number of cattle lakh population ⁻¹	X22
	Number of buffaloes lakh population ⁻¹	X23
	Number of sheep lakh population ⁻¹	X24
	Number of goats lakh population ⁻¹	X25
	Number of poultry lakh population ⁻¹	X26
	Number of veterinary institutions in the state	X27

Table 5. Agricultural development status

Rank	District	Composite index (↓)	Normalized index (↑)	PC value (↑)	District	Rank
1	Karnal	0.768	1.000	1.822	Yamunanagar	1
2	Kurukshetra	0.780	0.943	1.080	Karnal	2
3	Yamunanagar	0.788	0.902	1.070	Kurukshetra	3
4	Jind	0.815	0.773	1.016	Jind	4
5	Kaithal	0.816	0.769	0.963	Sirsa	5
6	Sirsa	0.825	0.727	0.781	Ambala	6
7	Hisar	0.825	0.726	0.563	Kaithal	7
8	Bhiwani*	0.830	0.703	0.325	Fatehabad	8
9	Ambala	0.851	0.600	0.267	Sonipat	9
10	Fatehabad	0.865	0.533	0.202	Panipat	10
11	Palwal	0.865	0.530	0.057	Palwal	11
12	Sonipat	0.892	0.399	0.050	Hisar	12
13	Mahendragarh	0.900	0.361	-0.421	Rohtak	13
14	Rohtak	0.903	0.351	-0.464	Bhiwani*	14
15	Jhajjar	0.931	0.214	-0.471	Mahendragarh	15
16	Panipat	0.931	0.214	-0.525	Panchkula	16
17	Panchkula	0.933	0.204	-0.968	Faridabad	17
18	Rewari	0.936	0.192	-1.099	Nuh	18
19	Faridabad	0.961	0.069	-1.222	Gurugram	19
20	Gurugram	0.964	0.055	-1.370	Rewari	20
21	Nuh	0.975	0.000	-1.656	Jhajjar	21

*Bhiwan includes the values of CharkhiDadri

Table 6. Important indicators in agricultural development

Indicator	Component				
	1	2	3	4	5
X1	Percentage of forest area to total geographical area			-.827	
X2	Percentage of net area sown to total cultivable area				
X3	Percentage of area sown more than once to total cultivable area				.786
X4	Net area irrigated percentage to net area sown				
X5	Percentage of total cereals area to total cropped area	.918			
X6	Percentage of total pulses area to total cropped area	-.781			
X7	Percentage of total food-grains area to total cropped area	.914			
X8	Percentage of total oilseeds area to total cropped area	-.755			
X9	Average land holding size				
X10	Total cereals yield		.928		
X11	Total pulses yield				
X12	Total food-grains yield		.907		
X13	Total oilseeds yield				
X14	Number of tractors 000 ha ⁻¹ of total cropped area				
X15	Number of tube-wells and pumping sets	.821			
X16	Percentage of cultivator worker to total workers				
X17	Percentage of agriculture worker to total workers			.835	
X18	Irrigation intensity (gross irrigated area x 100/net irrigated area)				
X19	Fertilizer consumption kg per ha ⁻¹				
X20	Regulated markets				
X21	Rainfall annual (cm) 2019			-.774	
X22	No. of cattle per lakh population		.822		
X23	No. of buffaloes per lakh population			.846	
X24	No. of sheep per lakh population				
X25	No. of goats per lakh population				
X26	No. of poultry per lakh population				-.903
X27	Number of veterinary institutions in the state				

development index (Tanwar et al 2016). Indicators X5, X7 (percentage of total cereals and food-grains area to total cropped area) and X15 (number of tube-wells and pumping sets) are the most important variables for first PC from the agricultural sector (Table 6). The other five indicators from PC2 and PC3 with higher loadings were X10, X12 (total cereals yield), X12 (total food-grains yield), and X17 (percentage of agriculture worker to total workers), X22 (number of cattle per lakh population) and X23 (number of buffaloes per lakh population⁻¹).

CONCLUSION

The present investigation indicated that inter-district disparities in Haryana in both the sectors. Gurugram, Faridabad and Panchkula were among the highly developed districts in socio-economic sector. Nuh was found lagging

behind in both the sectors. It was observed that percentage of urban population to total, population density, number of registered factories, working force in factories and transport related indicators were the important variables in the socio-economic sector development. Percentage of total cultivated land, irrigation facilities, the yield of cereals per acre of cropped area and the percentage of agricultural workers were found to be major contributors to the agricultural sector's growth.

REFERENCES

- Chander S 2017. Crop Combination region: A Spatio-temporal analysis of Haryana: 1990-93 & 2009-12. *South -Asian Journal of Multidisciplinary Studies* 4(5): 212-27.
- Das A, Khan A and Daspatanayak P 2016. Regional model for agricultural imbalances in West Bengal, India. *Modeling Earth systems and Environment* 2(58): 2-58.
- Hooda E, Hooda BK and Manocha V 2017. Dynamics of interdistrict

- developmental disparities in Haryana. *Journal of Applied and Natural Science* **9**(2): 983-991.
- Kumar N and Rani R 2019. Regional disparities in social development: Evidence from states and union territories of India. *South Asian Survey* **26**(1): 1-27.
- Muthumurugan P and Christina JSM 2021. Regional differences of agricultural development in Tamil Nadu: A district-wise analysis. *Indian Journal of Economics and Development* **9**: 1-9.
- Mishra P, Ray S, Abotaleb M, Abdullah M.G, Al Khatib, Tiwari S, Badr A and Balloo R 2021. Estimation of fish production in India using ARIMA, Holt's, Linear, BATS and TBATS Models. *Indian Journal of Ecology* **48**(5): 1254-1261.
- Mishra PK, Padmanaba and Meenakshee Dwivedi 2017 Modelling and forecasting of black pepper production in India. *Indian Journal of Ecology* **44**(4): 741-745.
- Narain P, Rai SC and Shanti S 1991. Statistical evaluation of development on socioeconomic front. *Journal of Indian Society of Agricultural Statistics* **43**: 329-345.
- Prabhakaran D, Jeemon P, Sharma M, Roth GA, Johnson C and Harikrishnan S 2018. The changing patterns of cardiovascular diseases and their risk factors in the states of India: the global burden of disease study 1990–2016. *Lancet Glob Health* **6**(12): e1339-51.
- Singh S, Jones AD and Jain M 2020. Regional differences in agricultural and socioeconomic factors associated with farmer household dietary diversity in India. *PLoS* (4): e0231107. <https://doi.org/10.1371/journal.pone.0231107>
- Tanwar N, Tyagi S, Sisodia BVS and Hooda BK 2016. Dynamics of socio-economic development of districts of Eastern Uttar Pradesh. *Journal of Applied and Natural Science* **8**(1):5-9.
- Van DR, Filatova T, Geurts P, Van D and Veen A 2015. Empirical analysis of farmers' drought risk perception: Objective factors. *Personal Circumstances and Social Influence Risk Analysis* **35**: 741-755.

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