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An Analysis of Crop Diversification and Factor Affecting the Diversification in Sirsa District of Haryana

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ABSTRACT

The nature and level of plant diversity in the province of Haryana were analyzed by collecting second data for a period of 25 years from 1969 to 2017. The Crop Diversification index, entropy index, and multi-line retrospective analysis analyzed the environment, scope, and factors affecting plant diversity in Haryana. The result shows that the CDI value varied from 0.6189 to 0.6082 in the state of Sirsa from 1981-to 2016, showing a slight reduction in variability. However, during 2005-06 to 2015-16, CDI increased to 0.5897 from 0.6082, indicating variability. Crop diversity indicator found in the analysis that the efficiency of multiple determination (R2) in acreage varied from 0.74 to 0.81 and the total value, from 0.68 to 0.75 below the variance measures. The size of the farm (X1) had a significant negative relationship, and the variance meant that the smaller farms were very different. Although the level of irrigation was necessary, indicating that certified irrigation systems promote crop diversity and the inclusion of high-value crops in production systems.

Keywords: Variety, Crop Variation Index, Entropy Index

Since independence, India had achieved remarkable growth in the agricultural sector when grain was 50.8 MT, and food grains in 2018 were 285.21 MT (Economic Survey, 2019). That is achieved thanks to improved technology and other innovative ways in which crop diversity is one of the agricultural processes that improve farmers' Income. Technological changes by introducing short-term varieties of wheat and rice that are highly productive in the sixties have increased the production of these crops in large quantities. Effective pricing policy and superior technology have led to the emergence of paddy in Kharif and wheat in rabbi as safe and very beneficial plants in a few regions. So in India, wheat and rice production increased sharply by 2.82 and 1.86 percent per annum from 1970-71 to 2013-14 and total crop prices respectively from 95.8 and 106.3 MT in 2013-14 from 23.27-2 at 23. 71 (*Sources:* India's Economic Survey) The start of the green revolution has intensified, and your trend is still growing and reaching 85% of the state's total area.

The production and production of wheat and rice in India have reached a point where it is complete. But farmers in the more developed agricultural regions such as the Punjab and Haryana still prefer to grow

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wheat and rice even though they are known for the problems that cause soil erosion declining water levels. Production, production, and profits that reached the highest levels in the leading regions of the green revolution began to be immersed in the early eighties. These changes indicate that the country will have a higher grain surplus, so farmers should diversify their crops by increasing pulses, oilseeds, fruits, vegetables, and cash crops.

Crop diversity is when one crop is reduced, and farmers aim to grow more than one profitable crop. Plant varieties grow in a wide area to reduce the risk of single plant failure. The transition from growing vegetation from conventional low-yield to high-quality crops is often seen in crop differentiation. As a result of government interventions or policies, crop rotation (diversity) is tracked in landfills and plants over time. For example, the Technology Mission on Oilseeds (T.M.O.) construction guides oilseed production, and the country can become self-sufficient in oilseed plants. Therefore, it can reduce oil imports. Various factors such as the price paid for biodiversity, market infrastructure, research and development, other local government support, and local-based crop growth incentives are crucial in promoting plant diversity. Nowadays, farmers use new techniques and more productive and high-value crops as spices.

MATERIALS AND METHODS

The study was conducted in Sirsa districts in Haryana province and collected critical data through a discussion program from a selected 2015-16 annual survey sample. Compiled secondary data were from various published and unpublished sources.

A Multistage random sampling technique was used to select the final sample units for the study. Regional selection formed the first phase of a sample Sirsa region from Zone-I chosen for research purposes. Block selection includes the second phase of the sample. The Fatehabad region consists of seven blocks: Fatehabad, Tohana, Ratia, Nagpur, Bhuna, Bhattu Kalan, and Jakhal. Three blocks, namely, Fatehabad, Ratia, and Tohana from the Fatehabad region, were randomly selected. Village selection forms the third phase of the sample. In all selected blocks, five villages from each block were randomly selected. Therefore, 15 villages in three blocks were chosen to select respondents. Prepared a list of functional areas from selected villages —a list of the active regions selected for the Fatehabad district to decide farmers' respondents. Operating funds are increasingly organized to accommodate increased frequency. Finally, the aggregate amount of active material was divided into small, medium, and large groups. Eventually, 150 sample farmers were selected for each area. Respondents were interviewed in person with the help of a well-planned and pre-scheduled schedule to collect relevant data to fulfill the study's purpose thoroughly.

Analysis tool

Steps for diversity

To measure the level of biodiversity in agriculture, there are two steps. Herfindahl and Entropy references were made.

Crop Variation Index

$$H = \sum_{\left(i=1\left(P_i^2\right)\right)^n}$$

$$P_i = A_i / \left(\sum_{\left(i=1\left(A_i\right)\right)^n} \right)$$

P_i = Part of the plant

A_1 = Sub-area (ha)

$\sum_{\left(i=1\left(A_i\right)\right)^n}$ = Total cut off area (ha)

i = 1, 2, 3 ..... n (number of plants)

The Herfindahl Index (H.I.) is defined as the sum of the squares of all the measured concentrations of the plants. This measure measures crop diversity in terms of acreage and crop residues. The value of 'H.I.' varies from zero to zero. It takes the Importance of one.

If there is a perfect specialty, it approaches zero when the number indicates the entire range. But to quantify the effects, a biodiversity index was developed:

$$C.D.I. = 1 - H.I.$$

There,

H.I. = Herfindahl Index

The C.D.I. has a direct relationship with diversity. The zero value of the CDI indicates exceptionality and progress in reflecting the increase in the number of businesses. It is also measured in part of the acreage and the remainder of the revenue.

Entropy Index

$$E.I. = \sum_{\left(i=1\left(P_i^2\right)\right)^n} \log 1/P_i$$

There,

P_i = part of the plant

The Entropy Index is considered the opposite of the concentration of plants with a logarithmic character. This measure is used in acreage estimates and the remainder of Income to measure plant diversity. The value of 'E.I.' varies from zero to one. The zero value of 'E.I.' indicates total expertise, while the value of one indicates complete diversity, which directly relates to variety.

Flexible Selection of Econometric model

Selected external variables included in the empirical model external variables included in the practical model based on existing literature on agricultural diversity (Kumar and Gupta, 2015; Birthal *et al.* 2006) and the relationship between farm income and agricultural diversity (Birthal *et al.* 2015; Bravo-Ureta) *et al.* 2006).

Description of variables included in the empirical model

Econometric Model

Farm Income = *f* (Variety, Size of Farm, Irrigation, Wealth, Education, Livestock Number, etc.)

$$In\ Y = \alpha_2 \sum_{(i=1)}^{n} \left[\beta y_i X_i + u_i\right] \qquad \ldots(1)$$

Diversity = f (Farm Income, Farm Size, Irrigation, Wealth, Education, Livestock Number, etc.)

$$MSID_t = \alpha_1 + \sum_{(j=1)}^{n} \left[\beta D_j + X_j + u_j\right] \qquad \ldots(2)$$

where *Y* is a farm benefit, MSID is a Simpson index modified to measure the diversity of agricultural activities included, and X_i and X_j represent all external variables included in the statistical system.

Multi-line retrospective analysis

Performed multi-line retrospective analysis to establish a proven relationship between different crop diversity measures (i.e., Herfindahi and Entropy indicators) on acreage estimates and the remainder of Income from farm samples with selective social and economic transformation. Independent variables are considered to define relationships, and dependent variables such as:

Line number

Where

Y: (.D.I or El. I.e., Crop Diversification Index or Entropy Index is calculated using space and Income under each crop under each farm (formula already mentioned)

X1: Size per hectare per farm

X3: - 5 family members working in agriculture on each farm

X2 = Farm distance from the regulated market near Km

X4: Irrigation capacity (measured as the area of the most irrigated area and the size of the net)

X5: Income per hectare per rupees

X6: Cost per hectare per rupees

Bi = Decreased coefficient of jth variable

a = Always

A computer performs Zero-order order processing to detect the multi-co-linearity problem. Independent variants with high affinity and dependent variability have been maintained among the collinear variables. Therefore, the final retrospective model was restarted with only the non-collinear and significant variables considered.

Used a less common square method to measure the efficiency of the retreat. The mathematical significance of this collaboration is made with the help of 'student' assessment at a selected level of Importance. The coefficient of multiple determinations (R2) is computerized to determine the overall suitability of the model.

Indicators of diversity at the regional level

Two steps to diversity viz. The Crop Diversification Index and the Entropy Index are 1980-81 to 2015-16 in selected districts in Haryana, namely Fatehabad and Sirsa. These indices are derived from plants, namely paddy, wheat, other grains (bajra, jowar, corn, barley), gram, other pulses (moong, masar, soybeans, field peas, arhar, cowpea), rapeseed, and other oilseeds (castor, linseed, sesamum, sunflower, nuts, taramira), cotton, sugarcane, fruits, and vegetables are included.

Crop Diversification Index (CDI)

Table 1 shows the Crop Diversity Index per hectare in the Sirsa districts of Haryana between 1980-81 to 2015-16. The results showed that the CDI value varied from 0.6189 to 0.6082 in the state of Sirsa from 1981-to 2016, showing a slight decrease in variability. However, during 2005-06 to 2015-16, CDI increased to 0.5897 from 0.6082, indicating variability.

Table 1: Crop Biodiversity Index in Faridabad and Sirsa District of Haryana: 1981-2016

Year	Sirsa
1980-81	0.6189
1985-86	0.6093
1990-91	0.6018
1995-96	0.5984
2000-01	0.5815
2005-06	0.5897
2010-11	0.5964
2015-16	0.6082

Entropy Index (E.I.)

Table 2 shows the Entropy Index for plant diversity in number per hectare in both selected Haryana regions between 1980-81 and 2015-16. The results showed that the value of E.I. varies from 0.5655 to 0.5420 in the case of the Sirsa region from 1981-to 2016, showing Reduced diversity.

Therefore, it concluded from the table that the variety of plants is more significant than in the Sirsa region. From 2005-06 to 2015-16 plant diversity increased. The widespread acceptance of plants for a sprinkler-irrigation system varies from leading businesses. Crops are also very diverse due to the large-scale diversion from conventional field crops to high-value crops such as vegetable crops, fruits, and flowers due to technological advances and the need gap.

Table 2: Index of Sirsa Crop Entropy in Haryana: 1981-2016

Year	Sirsa
1980-81	0.5655
1985-86	0.5430
1990-91	0.4837
1995-96	0.4837
2000-01	0.4975
2005-06	0.4843
2010-11	0.5180
2015-16	0.5420

The continued wheat rotation has resulted in weed infestation (tiny Paris), repetition of pests and diseases of problems, and soil erosion in the Sirsa region, which has resulted in an increase in the area under sunflower sugarcane and high-value crops.

Sirsa Region

In terms of acreage, the values of C.D.I. from 0.5837 on large farms to 0.6630 on small farms. At the same time, E.I. was rated at 0.6565, 0.6121, and 0.5538 on small, medium, and large farms, respectively. The total value of both Indices is 0.6271 and 0.6343, respectively. The highest number of C.D.I. on average, the income balance was 0.6967, 0.6461, and 0.5948 on small, medium, and large farms, respectively. At the same time, the value of E.I. varied from 0.5598 on large farms to 0.6789 on small farms. The total value of both indicators for the acreage component was 0.6271 0.5343, while for the revenue share, these were 0.6459 0.6211, respectively.

Both Table 3 concluded that the total number of indicators showed a positive degree of variability between plant businesses in both acreage estimates and the However, the farms are very different in Fatehabad district compared to Sirsa district because wheat and paddy are considered the most significant part of the cultivated area. Prices for both indicators in Fatehabad and Sirsa districts on different farm

categories indicated that smaller farms were higher due to the introduction of vegetable crops. Indicative prices for the share of Income were increased compared to half a hectare in different sections of the farms, which showed that some crops made a lower share of acreage but a larger share of the Income.

Table 3: Indication of variability in farm samples in Sirsa region: 2015-16

Category of farm	Acreage proportion		Net income proportion	
	Crop Diversifi-cation index	Entropy index	Crop Diversifi-cation index	Entropy index
Small	0.6630	0.6565	0.6967	0.6789
Medium	0.6345	0.6121	0.6461	0.6245
Large	0.5837	0. 5538	0.5948	0.5598
Overall	0.6271	0.6343	0.6459	0.6211

Biodiversity issues in the Sirsa region

Performed a descent analysis to examine the relationship between crop diversity measures (Crop Diversity and Entropy indicators) on a hectare and residual values for selected socio-economic variables in farm samples in the Sirsa region. The co-efficient derivatives are shown in Tables 4 and 5. It was found in the study that the efficiency of multiple determination (R2) per acreage range varied from 0.74 to 0.81, and the total value, from 0.68 to 0.75, was below the variance measures. This resulted in a percentage variation in the level of plant diversity defined by the six varieties included in the analysis. The size of the farm (X1) had a significant negative relationship, and the variance meant that the smaller farms were very different. Although the level of irrigation was substantial, indicating that certified irrigation systems promote crop diversity and the inclusion of high-value crops in production systems.

The number of family members working in agriculture (X3) and the remainder of the Income per hectare (X5) have positively contributed to the division, resulting in farms being significantly different in terms of increasing family members and Income per hectare. Found the distance from the market to be unfairly at the 10% value point, indicating that farms are not significantly different in remote areas. The working per hectare required will be less critical for both districts because the money spent can be made available at the regular interest rate.

Unexplained variations in both regions may be mainly due to physio-climatic factors such as soil type, rainfall, and other economic factors such as the need for high-value crops due to rising income levels, low legal support prices, market conditions, changing food habits. The variability in crop diversity was very high in the Sirsa region with unit changes in irrigation temperature. While I was in the Sirsa region, a variety of divers, in turn, significantly contributed to the evolution of the unit by the size of the legends and the number of family members involved in agriculture due to the limited availability of land per person.

Therefore, the findings indicated that crop diversity would increase in the Fatehabad region with the availability of irrigation water and its efficient use. However, the pressure on population growth

Table 4: Acreage reduction efficiency in Sirsa region: 2015-16

Independent variable dependent variable	Crop Diversification index	Entropy index
Constant	435.15	494.55
From size (x_1) (ha)	-19.43* (3.41)	-28.31* (4.21)
Distance from market (x_2) (km)	-4.76*** (2.71)	-5.29*** (2.91)
Number of family members engaged in agriculture (x_3)	14.41** (7.91)	19.21** (10.95)
Irrigation intensity (x_4)	64.18** (11.15)	119.25** (21.15)
Net income per hectare (x_2) (₹)	21.45** (12.01)	29.41** (15.91)
Working capital per hectare (x_6) (₹)	0.005^{NS} (0.028)	0.008^{NS} (0.049)
Co-efficient of multiple determination (R^2)	0.74	0.81

#Picture in brackets is a common mistake; * Important at 10% of Importance; ** Important at 5% Importance level; *** Important at 1% Value level; NS is not important.

Table 5: Proper reduction in income level in Sirsa region: 2015-16

Independent variable dependent variable	Crop Diversification index	Entropy index
Constant	559.95	712.31
From size (x_1) (ha)	-23.16* (3.97)	-38.02* (6.25)
Distance from market (x_2) (km)	-2.25*** (1.29)	-2.81*** (1.49)
Number of family members engaged in agriculture (x_3)	14.65** (8.25)	24.01** (13.45)
Irrigation intensity (x_4)	76.15** (30.99)	140.20** (55.31)
Working capital per hectare (x_6) (₹)	0.005^{NS} (0.025)	0.008^{NS} (0.035)
Co-efficient of multiple determination (R^2)	0.68	0.75

#Picture in brackets is a common mistake; * Important at 10% of Importance; ** Important at 5% Importance level; *** Important at 1% Value level; N.S. is not important.

at the farm level in both areas will be reduced by greater land use and the adoption of labor-intensive businesses. Finally, the results showed that large farms differed in both regions. The farms have a high level of irrigation and are close to other markets. The number of family members working in agriculture has also encouraged crop diversity at the farm level. Farmers were more focused on high-income businesses per hectare.

The analysis also illuminates policy tools to improve irrigation and marketing facilities that promote crop diversity and reduce yield and price risks. In addition, small farms should be very different in terms of farm benefit plans, and other farms may be required to use a certain degree of diversity.

CONCLUSION

Indicators of variability at the state level have shown a decrease in variability between different crops, grain crops, and non-grain crops between 2005-06 and 2015-16. The results showed that the CDI value varied from 0.6189 to 0.6082 in the state of Sirsa from 1981-to 2016, showing a slight decrease in variability. However, during 2005-06 to 2015-16, CDI increased to 0.5897 from 0.6082, indicating variability. Crop diversity indicator found in the analysis that the efficiency of multiple determination (R2) in acreage varied from 0.74 to 0.81 and the total value, from 0.68 to 0.75 below the variance measures. The size of the farm (X1) had a significant negative relationship, and the variance meant that the smaller farms were very different. Although the level of irrigation was important, indicating that certified irrigation systems promote crop diversity and the inclusion of high-value crops in production systems. The number of family members working in agriculture (X3) and the remainder of the Income per hectare (X5) have positively contributed to the division, resulting in farms being significantly different in terms of increasing family members and Income per hectare.

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