Vol XXXIX
No. 2

APRIL-
JUNE
1984

ISSN 0019-5014

INDIAN JOURNAL OF AGRICULTURAL ECONOMICS

INDIAN SOCIETY OF
AGRICULTURAL ECONOMICS,
BOMBAY

STRUCTURAL DISTRIBUTION OF OPERATIONAL HOLDINGS IN DIFFERENT ZONES OF PUNJAB

Punjab agriculture has witnessed a vast change since the mid-sixties with the beginning of green revolution. The green revolution has significantly altered the pattern of farm size in Punjab [Singh and Kahlon (1976)]. How did this affect the distribution of operational holdings in the three zones of Punjab* at the time when its impact had been evenly felt throughout the State is the central theme of this paper. More specifically, the objectives of this paper were (*i*) to examine the distribution of operational holdings in different size-groups in the three zones; (*ii*) to measure the coefficients of concentration for these distributions; (*iii*) to test whether any change has occurred in the structural distribution of holdings between 1975-76 and 1981-82; and (*iv*) to test whether these zones can be considered as homogeneous in respect of the distribution of holdings.

METHODOLOGY

The study was based upon the data collected under the "Comprehensive Scheme for Cost of Cultivation of Principal Crops in Punjab" rather than the Agricultural Census or National Sample Survey (NSS) Reports which have certain methodological and retabulation errors [Sanyal (1976), Rao (1976), Grewal, Kaul and Rangi (1977)]. According to Sanyal (1976), the methodology of retabulation from land records adopted by Agricultural Census (1970) has probably resulted in the over-enumeration of small holdings in the Agricultural Census. In Punjab, holdings below 0.5 acre constituted 6.65 per cent according to the 26th Round of the NSS but as high as 22.54 per cent in the Agricultural Census although the concept of operational holding is the same both for the NSS and Agricultural Census [(Sanyal (1976)]. To resolve this ambiguity, in the present study operational holdings were enumerated by personal contact method moving from door to door. For the purpose of this study, the State was demarcated into three homogeneous zones having regard to cropping pattern, irrigation, rainfall and soil types. Wheat being the common *rabi* crop throughout the State, the zones were identified on the basis of major *kharif* crop. Thus zone I, with paddy as the major crop, was called paddy zone and similarly zones II and III were called maize and cotton zones respectively. Zone I consisted of 21 tehsils lying in the north-west part of the State. Zone II consisted of 12 tehsils forming the central part of the State and zone III with remaining 9 tehsils formed the south-western part of the State. These zones had 41.85, 27.60 and 30.55 per cent of the cultivated area of the State respectively. In 1981-82 on the basis of area under four principal crops of Punjab, namely, paddy, wheat, maize and cotton, 20 tehsils were allocated to the three zones with 9, 5 and 6 tehsils respectively in these zones. This allocation number was the same as if with probability propor-

*Punjab State has been divided into three homogeneous zones on the basis of crop-climate-soil complex.

tional to the cultivated area of the zones. On this basis, for 1975-76 thirteen tehsils were taken with the allocation of 5, 4 and 4 tehsils in these zones respectively. These tehsils were selected randomly from the zones. For each selected tehsil, one village was selected randomly. Then for each selected village a cluster of three villages was formed by taking the selected village as the nucleus and two contiguous villages, one each in the west and south direction as the other two villages. The data on operational holdings for these selected clusters were taken by Complete Enumeration Method. For 1981-82, the operational holdings of all these clusters were pooled, these were 3,752 in number, arranged in ascending order of size and divided into five size-groups, also further subdivided to make ten size categories, with approximately equal area in each strata using simple Area Cumulative Frequency Method. For comparison these size-groups were used for the classification of 1975-76 data where the total number of holdings studied was 2,623.

Lorenz ratio and Theil's concentration coefficient based upon his entropy concept [Theil (1967)] were used as measures of inequality. Theil's concept was used as it is decomposable and has all the desiderata* of a good measure [Bourguignon (1979)]. This property can help in assessing the grouping error [Atkinson (1975)] which in the present context called 'Within group' coefficient. Lorenz ratio was calculated by:

$$\text{Lorenz ratio} = 1 - \sum_{i=1}^{n} \frac{(P_i - P_{i-1})(Q_i + Q_{i-1})}{10{,}000}; \quad (P_0, Q_0) = (0.0)$$

where P_i = cumulative percentage of operational holdings upto ith size-group,

Q_i = cumulative percentage of area of operational holdings upto ith size-group,

and Theil's concentration coefficient was calculated by

$$I(x) = \text{Log } n - E(x) \text{ where } E(x) \text{ is Theil's Entropy}$$

$$= \sum_{i=1}^{n} x_i \text{ Log } n\, x_i$$

given by $E(x) = \sum_{i=1}^{n} x_i \text{ Log } \left(\frac{1}{x_i}\right)$

$$x_i = \frac{X_i}{\sum_{i=1}^{n} X_i}, \quad X_i > 0$$

X_i = number of holdings or operated area in ith size-group.

* It is differentiable, symmetric and homogeneous of degree zero.

Firstly, I (x) was calculated for ten size-groups, called the total. After grouping these ten to five broad groups, I(x) was calculated for these groups, and called it 'Between group', thus decomposing total into 'between' and 'within group.' This 'within group' is an indication of grouping error which guides us about the changes in the concentration of holdings. This is not possible with Lorenz ratio, though Lorenz curve gives some idea about the parts of the curve responsible for concentration but it fails when the curves intersect each other [Atkinson (1975)]. To test the change in the structural distribution of holdings between 1975-76 and 1981-82 for each of the size-groups two-sample t-test was applied on the percentage of holdings in the size-groups. The homogeneity of zones in respect of distribution of holdings was tested with the help of Bartlett's test [Kenney and Keeping (1974)] given by

$$\frac{n \text{ Log } \sum_{i=1}^{K} \frac{n_i s_i^2}{n} - \sum_{i=1}^{K} n_i \text{ Log } s_i^2}{1 + \frac{1}{3(k-1)}\left[\sum_{i=1}^{k}\left(\frac{1}{n_i}\right) - \frac{1}{n}\right]}$$

where K = number of zones = 3

n_i = number of observations

s_i^2 = estimate of the variance

$$n = \sum_{i=1}^{k} n_i$$

is distributed as Chi-square with (k — 1) degrees of freedom.

RESULTS AND DISCUSSION

Distribution of Holdings

The percentage distribution of operational holdings among different size-groups and three zones of Punjab is given in Table I. It was found that in 1981-82, 49.89, 22.45, 12.95, 8.81 and 5.90 per cent of the holdings were in the five size-groups respectively in zone I while in zone II the position was not much different inasmuch as 44.95, 23.30, 16.04, 9.34 and 6.37 per cent of the holdings respectively were in these groups. In zone III, the corresponding figures were 32.86, 21.53, 17.05, 14.31 and 14.25 per cent in these size-groups. The distribution was about similar in 1975-76 whose actual significance is discussed elsewhere in this paper. The distribution of holdings in 1981-82 for the State was 41.71, 22.28, 15.38, 11.19 and 9.44 per cent in

TABLE I—PERCENTAGE DISTRIBUTION OF OPERATIONAL HOLDINGS IN THE THREE ZONES OF PUNJAB IN 1975-76 AND 1981-82

Size category (acres)	Zone I		Zone II		Zone III		Overall for the State	
	1975-76	1981-82	1975-76	1981-82	1975-76	1981-82	1975-76	1981-82
1-4	18·58	20·38NS	10·50	10·66NS	8·46	9·82NS	12·39	13·70NS
5-8	33·11	29·51NS	35·03	34·29NS	24·29	23·04NS	29·93	28·01NS
1-8	51·69	49·89NS	45·53	44·95NS	32·75	32·86NS	42·32	41·71NS
9-10	13·74	10·50**	10·18	12·64NS	13·16	10·80NS	12·62	11·14NS
11-13	12·50	11·95NS	12·81	10·66NS	11·68	10·73NS	12·24	11·14NS
9-13	26·24	22·45NS	22·99	23·30NS	24·84	21·53NS	24·86	22·28NS
14-16	6·19	8·97	9·57	10·88NS	11·59	10·41NS	9·26	10·02NS
17-19	4·96	3·98NS	5·86	5·16NS	3·50	6·64*	4·57	5·36NS
14-19	11·15	12·95NS	15·43	16·04NS	15·09	17·05NS	13·83	15·38NS
20-24	4·84	6·21NS	6·33	5·82NS	9·11	9·30NS	6·98	7·38NS
25-28	1·91	2·60NS	4·32	3·52NS	5·24	5·01NS	3·89	3·81NS
20-28	6·75	8·81NS	10·65	9·34NS	14·35	14·31NS	10·87	11·19NS
29-35	2·48	2·84NS	3·24	2·86NS	6·53	6·77NS	4·35	4·45NS
36 and above	1·69	3·06NS	2·16	3·51NS	6·44	7·48NS	3·77	4·99NS
29 and above	4·17	5·90NS	5·40	6·37NS	12·97	14·25NS	8·12	9·44NS

* Significant at 5 per cent level.
** Significant at 1 per cent level.
NS=Non-significant.

these size-groups. As these size-groups were based on equal area in each group in 1981-82, this implied that about 42 per cent of small holdings covered 20 per cent of area compared to only 9 per cent of large holdings covering the same area.

Coefficients of Concentration

Lorenz ratio and Theil's coefficient of concentration calculated for the three zones and the two study years are given in Table II. Lorenz ratio for the two years showed that there was decrease in inequality in zone II and zone III though zone I showed a slight increase but for Punjab State, as a whole, this coefficient showed a decrease in inequality. Theil's total coefficient was more consistent in this prediction. It showed a decline in all the zones and the State as well. Grouping error in 1981-82 for Theil's index amounted to 0.0356, 0.0798 and 0.0484 for zones I, II and III respectively. Theil's concentration index for operated area showed its sensitivity to the grouping. Its index decreased from 0.0737, 0.0951 and 0.1073 for zones I, II and III in 1981-82 to 0.0056, 0.0024 and 0.0639 respectively in these zones after grouping, thus giving grouping error to the tune of 0.0681, 0.0827 and 0.0434 for these zones respectively. Though low values for this index for 'between groups' were expected, as the five size-groups were formed on the basis of equal area in these strata, yet the magnitude of the 'within groups' coefficients showed the extent of grouping error involved. Thus, it could be concluded from Theil's index that inequality in distribution of holdings as well as area had declined over time resulting in more even distribution of area among the holdings. Also this index is smaller in the case of operated area than the number of holdings, showing that area concentration is less compared to holdings in these size-groups. Also in general, the coefficients declined as the number of size-groups decreased.

The results of applying t-test to test the structural change in the ten size categories over the years showed (Table I) that in zone I except for the size category 9-10 acres there occurred no significant change. In this size category the decrease was highly significant, *i.e.*, from 13.74 per cent to 10.50 per cent of the holdings. Though in the other size categories changes have occurred, these were found to be non-significant. The test applied for the amalgamated five size-groups showed that no change was statistically significant. In zone II, for the five size-groups, there was marginal decrease in the first and the fourth group along with a marginal increase in the other groups but these marginal changes were also statistically non-significant. In zone III only one change in the sixth size category was significant at 5 per cent level, all the rest were non-significant. For the State, as a whole, no change was found to be significant even upto 10 per cent level of significance. Thus, taking the five size-groups, all the changes were non-significant in each of the zones and Punjab as a whole, showing that no structural change has occurred in the distribution of holdings over the study years.

TABLE II—LORENZ RATIO AND THEIL'S INDEX FOR NUMBER OF HOLDINGS AND OPERATED AREA FOR TWO STUDY YEARS AND THE THREE ZONES OF PUNJAB

Zone	Lorenz ratio		Theil's index for number of operational holdings						Theil's index for operated area					
			Total		Between group		Within group		Total		Between group		Within group	
	1975-76	1981-82	1975-76	1981-82	1975-76	1981-82	1975-76	1981-82	1975-76	1981-82	1975-76	1981-82	1975-76	1981-82
Zone I	0·3731	0·3803	0·3864	0·3069	0·3582	0·2713	0·0282	0·0356	0·1034	0·0737	0·0351	0·0056	0·0683	0·0681
Zone II	0·3570	0·3521	0·3066	0·2998	0·2277	0·2200	0·0789	0·0798	0·0916	0·0951	0·0056	0·0024	0·0860	0·0927
Zone III	0·3720	0·3671	0·1375	0·0939	0·0690	0·0455	0·0685	0·0484	0·1172	0·1073	0·0535	0·0639	0·0637	0·0434
Overall for the State ..	0·3674	0·3665	0·2311	0·1925	0·1808	0·1544	0·0503	0·0381	0·0686	0·0672	0·0052	0·0100	0·0634	0·0572

Table III presents the calculated F-value for 1975-76 and 1981-82 for each of the size categories and X^2 value for Bartlett's test. The majority of F-values are less than one, indicating non-significance of difference among

TABLE III—CALCULATED F-VALUE IN EACH OF THE SIZE CATEGORIES FOR ZONES AND X^2 VALUE IN 1975-76 AND 1981-82

Size category	Year	
	1975-76	1981-82
F-value		
1-4	< 1	< 1
5-8	< 1	< 1
1-8	< 1	< 1
9-10	< 1	< 1
11-13	< 1	< 1
9-13	< 1	< 1
14-16	1·73NS	< 1
17-19	< 1	< 1
14-19	< 1	< 1
20-24	< 1	< 1
25-28	< 1	< 1
20-28	< 1	< 1
29-35	1·32NS	< 1
36 and above	1·49NS	< 1
29 and above	1·75NS	< 1
X^2 value	3·3896NS	3·4231NS

NS=Non-significant.

the three zones for each of the size category. Even the other values were non-significant even upto the 10 per cent level of significance. This indicates equality of zones in terms of the distribution of holdings in each of the two study years for each of the categories. Values of Chi-square were non-

significant even upto 10 per cent significance level. This indicates the homogeneity among the three zones in respect of the distribution of operational holdings, *i.e.*, the three zones can be treated as one homogeneous zone. Thus as regards the operational holdings are concerned, the whole of the Punjab can be considered as one homogeneous zone.

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