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## MEASURES AND DETERMINANTS OF INEQUALITY IN FARM INCOME DISTRIBUTION IN INDIAN AGRICULTURE

By

\*A. S. Kahlon & H. K. Bal

### INTRODUCTION

There is some evidence to show that the distribution of income is highly skewed in Indian agriculture with a large number of incomes concentrated in a comparatively narrow range at the lower end of the distribution and relatively small number of incomes which spread over a wide range at the upper end. It is hypothesised that the recent breakthrough in the technology of foodgrain production will further affect the pattern of income distribution, particularly in the rural areas. This study is an attempt to examine whether changes in income distribution, resulting from the green revolution, have promoted greater equality, or have accentuated inequality in farm incomes, by increasing concentration in the hands of the large farmers. It has great practical importance, because a big shift in the trend in income distribution towards equality or away from equality, may have greater social and economic implications for the country.

In this context, we are confronted with the problem of identifying multi-various factors which affect income distribution. For this purpose, a model is built, which identifies the factors affecting the inequality of farm income distribution and the relative contribution of these economic factors to the inequality measure is discussed with the help of this model.

### METHODOLOGY

Various research workers have used a wide range of measures of inequality, such as mean deviation from mean, coefficient of variation,

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\*Dr. A. S. Kahlon is Dean, College of Basic Sciences & Humanities, Punjab Agricultural University, Ludhiana.

Mrs. H. K. Bal is Assistant Professor of Statistics, Department of Mathematics & Statistics, PAU, Ludhiana.

standard deviation and the most important of these, Gini's coefficient of concentration. Benson 1970, has, however, reported that the Gini's concentration ratio and Lorenz curve suffer from such limitations in the study of income distribution as inter and intra cell biases and difficulties involved in analysing sectoral sources of inequality. These inter and intra cell biases arise, when the Gini's concentration ratio is calculated from the Lorenz curve drawn by using the ungrouped data and can be even eliminated, if in addition to using the ungrouped data, the Gini ratio is determined by using equation of the Lorenz curve, which further requires the specification of the probability distribution of the income variable. Some research studies have shown that the probability distribution of income in India is lognormal. In this paper, lognormality of the distribution of farm income was tested using Probit analysis.

#### Concentration ratio between farm groups

To calculate the inequality ratio of the farm income distribution between farm groups, it was assumed that the bivariate distribution of farm size (X) and farm income per holding (Y) was lognormal. In that case, marginal distribution of log X was normal  $(0, \lambda)$  and conditional distribution of log Y for a given value of log X was also normal  $(\alpha + \eta \log X, \sigma^2)$  where  $\eta$  is the constant elasticity of farm income with respect to farm size.

If PC is the proportion of holdings with size  $\leq C$

$$p_c = \Phi \left( \frac{\log \frac{C-\theta}{\lambda}}{\lambda} \right) \dots \dots \dots 1.$$

where

$$\Phi(t) = \int_{-\infty}^t \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}u^2} du$$

The Proportion  $q_c$  of the total area held by these holdings is given by

$$q_c = \Phi \left( \frac{\log \frac{C-\theta}{\lambda} - \lambda}{\lambda} \right) \dots \dots \dots 2$$

Eliminating  $C$  from (1) and (2), we get the equation of the Lorenz curve, which relates the proportion of the area held to the proportion of farm holdings up to a given level of farm size:

$$t_q = t_p - \lambda \dots \dots \dots 3$$

where  $t$  is defined by the relation  $K = \Phi(t_K)$ ,  $0 \leq K \leq 1$

Similarly, proportion  $Q_C$  of the total farm income shared by holdings, whose farm size is  $C$  or less, is given by

$$Q_C = \Phi\left(\frac{\log \frac{C - \theta}{\lambda} - \lambda \eta}{\lambda}\right) \dots \dots \dots 4$$

Eliminating  $C$  from (1) and (4), we get the equation of the specific concentration curve, which relates the proportion of total farm income to the proportion of holdings up to a given level of farm size

$$t_Q = t_P - \lambda \eta \dots \dots \dots 5$$

$P_x = q_x = Q_x$  is the Egalitarian line.

To examine the concentration, Gini's ratio of concentration between farm size groups was worked out as:

$$\text{Concentration ratio for farm size} = 2 \Phi\left(\frac{\lambda}{\sqrt{2}}\right) - 1$$

$$\text{Concentration ratio for farm income (per holding) between farm size groups} = 2 \Phi\left(\frac{\lambda \eta}{\sqrt{2}}\right) - 1$$

If  $\frac{Y}{X}$  is the farm income per hectare, then it can be shown that the concentration ratio for farm income per hectare is equal to Concentration ratio for  $Y$  minus Concentration ratio for  $X$ . That is, the concentration ratio of the ratio of two lognormal variables is equal to the difference of their concentration ratios. This is a very important fact, which makes Gini ratio a very convenient tool for the measure of inequality under the assumption of the lognormality of the distribution of the study variable. This property is also helpful in bringing out the factor share in inequality.

MODELS

The following models were used to examine the relative contribution of the skewness of different socio-economic factors with regard to their effect on the distribution of farm income between farm size groups:

$$*Y = \frac{Y}{X_3} \cdot X_3 \dots\dots\dots(\text{identity})\dots\dots\dots(A)$$

$$\text{and } Y = \frac{Y}{X_1} \cdot \frac{X_1}{X_2} \cdot \frac{X_2}{X_3} \cdot \frac{X_3}{X_4} \cdot X_4 \text{ (identity)}\dots\dots\dots(B)$$

where Y = Gross farm income per holding  
 X<sub>1</sub> = Total cost per holding  
 X<sub>2</sub> = Variable cost per holding  
 X<sub>3</sub> = Farm size (hectares)  
 X<sub>4</sub> = Size of the family

Model (A) in the logarithmic form is

$$\log Y = \log (Y/X_3) + \log (X_3) \dots\dots\dots 6$$

$$\text{C.R.}(Y) = \text{C.R.}(Y/X_3) + \text{C.R.}(X_3) \dots\dots\dots 7$$

where  $Y/X_3$  is the farm income per hectare.

Under the assumption of the lognormality of the farm size and farm income distributions, this model brings out the relative contribution of the farm size and the farm income per hectare in explaining the disparity of farm income distribution between the farm size groups.

Model (B) can be rewritten as:

$$\log Y = \log (Y/X_1) + \log (X_1/X_2) + \log (X_2/X_3) + \log (X_3/X_4) + \log X_4 \dots 8$$

$$\text{C.R.}(Y) = \text{C.R.}(Y/X_1) + \text{C.R.}(X_1/X_2) + \text{C.R.}(X_2/X_3) + \text{C.R.}(X_3/X_4) + \text{C.R.}(X_4) \dots\dots\dots 9$$

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\*Since the major objective of the study was to measure the contribution of various factors towards increasing/reducing inequality in farm income, the concept of gross income rather than net income was used in setting up the identity.

And this is the break up of inequality of income distribution into different components, indicating the relative contribution of different factors. The various ratios can be interpreted as:

$$\frac{Y}{X_1} = \text{Returns to total cost effect}$$

$$\frac{X_1}{X_2} = \text{Fixed cost effect}$$

$$\frac{X_2}{X_3} = \text{Variable cost/hectare}$$

$$\frac{X_3}{X_4} = \text{Land-man ratio}$$

and  $X_4$  = Size of the family

#### Positive and negative skewness

It is evident that the Lorenz curve always lies below the egalitarian line, but the specific concentration curve may lie below or above this line of equal distribution. If the condition distribution of any factor for a given farm size is positively skewed, the specific concentration curve will be below the egalitarian line. And for the conditional distribution, which indicates negative skewness, the specific concentration curve will be above the line of equal distribution. Thus the concentration ratios will be assigned positive or negative signs, according to whether the specific concentration curves are below or above the line of equal distribution.

#### DATA

For the purpose of calculating the inequality in the farm income distribution between farm size groups, the data collected through Farm Management Surveys in the Punjab, Gujarat, Orissa, and Tamil Nadu States were used. These states were selected purposely to represent the four zones of India. The North, South, East and West zones were represented by the States of Punjab, Tamil, Nadu, Gujarat and Orissa respectively.

The data used in this study relate to 1968-69 and 1969-70 for Punjab, Orissa, and Tamil Nadu. For Gujarat State, the data relate to 1967-68 and 1968-69, because the survey in this State was started one year earlier than in the other states. These two years' data help in working out the growth rates of farm income and also to study the change in disparity in the farm income distribution.

### RESULTS AND DISCUSSION

#### Distribution of farm size

It was evident that the Punjab State has larger holdings as compared to the other States. Average size of holdings in Punjab was 8.60 hectares in 1968-69 and 8.46 in hectares 1969-70. The States of Orissa and Tamil Nadu had relatively very small holdings, the average farm size being 1.1 hectare in Orissa and 1.7 hectares in Tamil Nadu.

The concentration of the farm holdings between farm size groups revealed that the concentration was the least in the Punjab State, where lower 48 per cent of the holdings held 20 per cent of the total cultivated area. In Gujarat State, the concentration was the highest and 20 per cent of the cultivated area was held by the lower 62 per cent of the holdings. In the States of Orissa and Tamil Nadu, 20 per cent of cultivated area was held by 50 per cent and 55 per cent of holdings respectively.

Lognormality of the farm size distribution was tested, using the Probit analysis.

#### Distribution of farm income between farm size groups

The farm income per holding increased with the farm size but gross farm income per hectare decreased with the increase in farm size. Farm income per holding increased from 1968-69 to 1969-70 by 18.56 per cent in the Punjab and by 7.83 per cent in Tamil Nadu. In Gujarat State, this income increased by 38.25 per cent from 1967-68 to 1968-69.



These results further show that the small holdings (48 per cent in Punjab, 62 per cent in Gujarat, 50 per cent in Orissa and 55 per cent in Tamil Nadu), which shared 20 percent of the cultivated area, shared the total farm income to the extent of only 25 per cent in Punjab, 22 to 24 per cent in Gujarat, 23 to 26 per cent in Orissa and 24 to 25 per cent in Tamil Nadu State. On the other hand, the largest holdings, which formed only 3 to 6 per cent of the total number of holdings, but held 20 per cent of the cultivated area, shared farm income to the extent of 19 per cent in Punjab, 24 per cent in Gujarat, 11 per cent in Orissa and 15 per cent in Tamil Nadu during the first year of the study. The percentage share of farm income held by these large farms slightly declined in the Punjab State, but in the other States, the income share of these holdings further increased during the second year of the study.

#### Inequality measures

Results of the farm size and income analysis showed that a 10 per cent increase in farm size increased the farm income (per holding) by 9 to 10 per cent in the Punjab and between 8 to 9 per cent in other States. This gave an indication that the disparity in the farm income distribution between farm size groups could be mostly attributed to the disparity in the farm size distribution.

The disparity in the farm size distribution was the highest (0.53 and 0.51) in Gujarat and Tamil Nadu. This resulted in the higher inequality in farm income per holding, for which the concentration ratios were 0.47 and 0.48 for Gujarat and 0.44 and 0.43 for Tamil Nadu during the period under study. The results also showed that nearer the farm size elasticity ( $\eta$ ) of farm income to one, the closer were the concentration ratios of farm income and farm size.

The analysis also indicates that the inequality in the farm income distribution between the farm size groups increased in all the States over this period, except for Tamil Nadu State, where the concentration ratio declined from 0.438 to 0.431.

Who benefited more

The farm income of all types of farms (small or large) increased with the adoption of new farm technology in the States of Punjab, Gujarat and Tamil Nadu with the exception of Orissa State, where all size groups suffered a decline. Rate of growth approach was used to study whether the large or the small farms benefited more in the States, which experienced positive rate of growth. This analysis did not establish a definite trend of the rate of growth of income with the farm size. In the Punjab State, the rate of growth of income was lower on very small and very large farms. It was the highest for the medium farms. In this State, the highest rate of growth of 27.90 per cent was experienced by farms between 9 to 14 hectares. Rate of growth of farm income was the lowest on very large farms (above 24 hectares). In the States of Gujarat and Tamil Nadu, the picture was just the reverse of Punjab. The rate of growth of farm income was the highest (13 to 14 per cent) on very large and very small farms in Tamil Nadu. In this State, the medium-sized farms experienced only 0.34 per cent increase in income. In Gujarat State, the large farms (above 10 hectares) experienced 54 per cent increase in the income.

To test the differences in the rate of growth of income between size groups, analysis of variance\* was done for each State, except Orissa.\*\* The F-values turned out to be significant at 5 per cent level.

\*This analysis was done on log R because the distribution of R (the rate of growth) was lognormal.

\*\*In case of Orissa the rate of growth was negative.

### Determinants of inequality

The results of the previous sections show that the distribution of farm income per holding was very much affected by the distribution of farm size. And other economic factors such as the structure of costs in the farm business analysis, which affected the farm income of distribution, were themselves affected by the farm size distribution. Size of the family was also expected to vary with the farm size. Therefore, the study the relative contribution of these factors to the inequality of farm income distribution, the distribution of these factors between the farm size groups was studied.

The analysis of this section was done with the help of the model (B) which provided the contribution of the selected factors to the inequality of the farm income distribution between farm groups. It was seen that the land-man ratio contributed the most towards accentuating inequality. This factor alone explained 83 to 100 per cent of the inequality in the farm income distribution, which resulted mainly from the skewness in the farm size distribution.

Next in importance was the family size factor, which contributed 27.96, 15.38, 35.79 and 20.00 per cent towards the farm income inequality in the Punjab, Gujarat, Orissa and Tamil Nadu respectively during the first year of the study. The effect of this factor on the skewness of the farm income distribution was reflected through the availability of the family labour.

Returns to fixed cost effect had relatively small but positive contribution i.e. 2.58, 7.71 and 8.04 per cent respectively for the Punjab, Gujarat and Tamil Nadu during the first year of this study. In Orissa, the percentage share of this factor was about 5 per cent, but it carried a negative sign, which means that the returns to fixed cost were more on small farms than on the large farms in this State. The positive effect of fixed cost in the Punjab situation during both the years shows that fixed cost investment effect increased with the increase in farm size. In the States of Gujarat

and Orissa, fixed cost effect was negative during the first year of study. But as the large farmers started building up their infrastructure, this effect turned out to be positive during the second year of the study. However, the contribution of this factor was relatively small in these States. Fixed cost effect was still dominant on small farms of Tamil Nadu, because this factor contributed to reduction in farm income inequality during both the years of study.

The distribution of variable cost per hectare contributed towards reduction in inequality in farm income. This factor reduced the disparity in farm income distribution by 24.65, 22.11, 15.42 and 14.84 per cent during the first year of the study in Punjab, Gujarat, Orissa and Tamil Nadu respectively. It indicates that the small farmers invested more on their farms, which in turn increased their incomes.

#### Change in disparity in income and factor share

The change in the disparity coefficients of different factors and their contribution to the percentage change in the disparity coefficient of the farm income distribution over the years of study were also studied. The results show that the inequality in farm income distribution increased by 8.96, 2.36 and 13.62 per cent in the Punjab, Gujarat and Orissa respectively. In Tamil Nadu, there was a slight decline (1.51 per cent) in the disparity of farm income distribution.

The major factor which resulted in the increase in farm income inequality in the Punjab, Gujarat and Tamil Nadu, turned out to be the returns to total cost effect. This factor alone increased the farm income inequality by 9.28 per cent in the Punjab State, 4.35 per cent in Gujarat and 2.32 per cent in Tamil Nadu State. The change in the fixed cost distribution also resulted in further increase of 4.01 and 2.42 per cent in farm income inequality in Punjab and Gujarat States.

The change in the distribution of the variable cost per hectare reduced the disparity in farm income inequality by 4.33 per cent in the Punjab and 4.41 per cent in Gujarat State.

To summarize:

- (i) At a point of time, the size of the farm contributed the most towards inequality in farm incomes.
- (ii) The incomes of the small farmers increased over this period, but a rapid rate of increase in the incomes of the large farmers resulted into further increase in disparity in income between the small and large farmers. This disparity resulted mostly from the build up of better infrastructure on the large farms.
- (iii) Considering the paucity of the data, the results of the study may not be conclusive but they certainly indicate the trend that income distribution is taking among the small and the large farmers in different regions of India.

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